Argentina's Machine Tool Sector

Eduardo P. Amadeo, Roberto F. Fernandez, and Fernando Morales

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ARGENTINE'S MACHINE TOOL SECTOR

by

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1. Introduction

This report presents the sectorial analysis on the machine tools sector, carried out within the framework of the Research Project on Instruments of Scientific and Technological Policy, sponsored by the International Development Research Centre.

The central goal of the project is to obtain and analyze information necessary to design and implement policies for science and technology. Within the Project, the attempt is made to reach this goal through various means, both in what refers to types of problems studied and methodologies.

In the specific case of the machine tools sector, the work reported here constitutes an attempt at analyzing the set of elements that make up the framework within which the entrepreneurs of the sector make their technological decisions; in addition, an effort was made to gain some knowledge on the characteristics of these decisions. The starting hypothesis, therefore, is that technological decisions are the result of a complex whole of interactions, in which the following elements intervene: a) the general characteristics of the sector's insertion within the structure and dynamics of the economy; b) the production structure of the sector itself; c) the firm's own characteristics, distinguishing within the latter those corresponding to: 1) "economic" variables; 2) technological capability; 3) management capability; d) the environment of technological support, particularly the agencies of creation, extension and information; e) certain sociological characteristics of the entrepreneurs of the sector, considered both individually and as a group.

Perhaps with the (relative) exception of the sociological characteristics of the entrepreneurs, none of the other variables
can be left out in developing and implementing a technological policy, which, one should emphasize, implies much more than a "policy for the technology". Partial policy statements may influence certain technological decisions of the entrepreneurs, but if one intends to make the whole set of decisions bearing on the productive dynamics of a sector follow a given rationality, the above mentioned aspects should be contemplated and integrated into one policy.

The research was planned and subsequently undertaken in the following fashion: first, a "macro" analysis was done in order to get some knowledge of the basic structural characteristics of the sector, its evolution in the past, and its relation with the dynamics of the whole. The second step was the design of a model that sought to explain the technological decisions as being the consequence of the five variables cited above. The main usefulness of this exercise - in which we had the key contribution of Dr. Francisco Suárez and Lic. Isidoro Feldman - was that it allowed to identify the main elements to be included in the survey.

The survey thus covered the following aspects:

- General characteristics of the firm: age, size, invoicing, capital, etc.
- External relations: customers and suppliers; characteristics of the relation.
- Technological situation: origins of the technology; subsequent modifications; activities of technological creation performed; "routine" activities; human infrastructure in the firm; relations with the environment (consultants, R and D agencies, etc.). Origin of the technological information.
- Management: characteristics of the main areas of administrative management: sales, finances, personnel, information, pur-
chases, planning and control of production.

- Instruments: knowledge, utilization, destination, opinion.

Relations with the State as a buyer.

- Technological structure: capital goods; origins, age, etc.

Twenty-three firms producing machine tools were surveyed, which represent over 60% of the production value of the sector. In addition, 5 manufacturers of parts and accessories, 2 users of machine tools and 5 distributors were interviewed.

The result of the survey - in general terms - may be considered satisfactory. The only aspects for which reliable information was not obtained were the following: rate of profits, sales at the firm level, average age of the capital equipment, and development projects held as confidential. The lack of this information affected in part the conclusions, particularly in what refers to policy and structure of investments at the firm level.

Once the results of the survey were tabulated, a number of hypotheses were worked out and introduced in a second survey, designed to be answered by "key informants", having a long experience in the sector. The final proposals of this work stem from the information gathered in this fashion, as well as from the team's own elaboration.

Some complementary work was also performed, such as: an analysis of the characteristics of the machine tools technological evolution at the world level; a compilation of information on the technical-economic characteristics of numerically controlled machine tools; and a study of the San Francisco Industrial Park, which the team considers to be a valuable forerunner in rational industrial policy.
Perhaps the whole approach, and even the conclusions and proposals, cannot be fitted into a rigorous model of analysis of sectorial technological development. The goals were much more modest, since - as it was stated at the beginning - the intention was to know the framework within which the technological decisions are taken at the firm level, with the objective of proposing policies.

A final question should perhaps have been posed at the beginning; why was the machine tools sector chosen? The reasons are the following: it is a sector of small and medium firms in which studies on technological decisions are rather scarce. Moreover, it is a sector whose importance in macroeconomic terms is insignificant, if one looks at its labor absorption capacity, volume of sales, exports, etc. Nevertheless, a change in the technological characteristics of the goods produced by the sector may affect the levels of productivity, precision, etc., of a large set of industrial sectors. Finally, one is dealing with a type of products through which, for reasons explained in this report, Argentina may achieve an important penetration in the rest of Latin America and other Third World countries.

2. History

The history of the machine tools sector starts at the beginning of the century, when in 1906 the first machines were manufactured in the country.

It originated mainly, such as most capital goods industries, in the process of repairing imported equipment, and grew as the difficulties for importing increased, albeit disjointedly and not integrated as a true industry.

Since they were repair shops rather than true factories, the
pioneering firms had to confront the strong imports of the first decades (from 1920 on), which acted as a factor hindering its growth; inasmuch as it was impossible to compete with the imported machines due to their better quality, tradition and price, many firms had to close down.

During World War II, a period during which imports were not allowed, the "unavoidable protectionism" encouraged again national industry, and in the 40's and the beginning of the 50's all the large firms of the sector got settled. Once the war was over, the Argentine market reinitiated its external trade, importing machine tools mainly from the U.S.A. and Europe. Those machines were of a type similar to the one then produced in the country, but of better quality, which put the newly settled firms at the brink of collapse.

In the mid50's the national factories started to strengthen their positions as producers, with imported production equipment that improved the quality of the national products and the deteriorated image the buyers had of them. This strengthening became finally effective at the beginning of the 60's, when due to the need to rely on a real machine tools industry, capable of offering the elements necessary for the new model of industrial development that was being prepared in the country, attention began to be paid to the fact that in order to ensure a firm development of the sector it was necessary to grant sufficient custom protection. The early birth of the sector is also reflected in the average age of the firms at present, such as it is shown in Table A. Seventy percent of the firms have an average age of 20 years, which is particularly significant if one considers the type of activity developed - metal working - for which experience is a prerequisite for the possibilities of innovation.
TABLE A: FIRMS AGE

<table>
<thead>
<tr>
<th>Age</th>
<th>Percentage</th>
<th>Number of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 20 years</td>
<td>36.8</td>
<td>24</td>
</tr>
<tr>
<td>Between 10 and 20</td>
<td>35.4</td>
<td>23</td>
</tr>
<tr>
<td>Between 5 and 10</td>
<td>13.9</td>
<td>9</td>
</tr>
<tr>
<td>Between 0 and 4</td>
<td>13.9</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: Sectorial Survey, quoted in the DGFM work.

Size

According to the personnel employed, the firms in this small sector may be classified into: large, i.e., employing over 45 workers; medium, i.e., with a labor force of over 20 people; small, i.e., having over 5 workers, and very small, i.e., factories having up to 5 workers employed.

This distribution by size categories shows that the small firms represent 66 percent of the machine tools sector, which produce 56.3 percent of the units and represents 18 percent of the production value of the sector.

This implies that the machine tools industry, just like the majority of national industries, presents itself as being fairly atomized in the lower strata, with a high number of units produced but with little relevance in terms of values - approximately US$500.00 per unit. This also shows the scarce technological sophistication of this type of goods.

In the "medium" category, distribution is more balanced, for it includes 21.3 percent of the firms and 31 percent of the units.
produced. Since its production value reaches 26.8 percent of the total, one can infer that the goods have a superior technological degree than those of the small category.

The large firms decisively stress the imbalance as regards technology, for in this category 12.8 percent of the firms produce 53.8 percent of the total production value. Discriminating in terms of types of machines, they represent 62 percent of the total of lathes, 64 percent of the milling machines, 85.4 percent of the benders and 46.1 percent of the working beams (to cite only the main products). But in number of units, they constitute only 12.7 percent of the total.

The high average value of these machine tools is evident: it approaches 7,000 dollars per unit, pointing then to the relatively high degree of technological sophistication that these productions imply to the local market.

<table>
<thead>
<tr>
<th>Persons employed size</th>
<th>Number of Firms %</th>
<th>Units %</th>
<th>Weight % (tons)</th>
<th>Amount % US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 45 large</td>
<td>12.8</td>
<td>1736</td>
<td>7626</td>
<td>12150</td>
</tr>
<tr>
<td>20-45 medium</td>
<td>21.3</td>
<td>4233</td>
<td>2936</td>
<td>5583</td>
</tr>
<tr>
<td>6-19 small</td>
<td>43.5</td>
<td>6813</td>
<td>2135</td>
<td>3962</td>
</tr>
<tr>
<td>0-5 very small</td>
<td>22.4</td>
<td>853</td>
<td>225</td>
<td>413</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>13653</td>
<td>12922</td>
<td>22108</td>
</tr>
</tbody>
</table>

Source: Sectorial survey, DGFM
Concentration

According to the study carried out by CONADE* - in which the main industrial branches are classified in terms of their degree of economic concentration into highly concentrated, fairly concentrated and scarcely concentrated - this sector, which was not included in the sample due to its scanty representativeness within the IGP, should be located into the fairly concentrated branch category, where 8 firms control from 25 to 50 percent of production.

Refining this concept further, one might refer to this sector as being highly concentrated in its higher stratum, in which 12 percent of the firms (from a total of 100 firms) possess 67 percent of the capital set up, 84 percent of the personnel employed in the industry and the already mentioned 53.8 percent of the total production value. On the other hand, they present the largest capital labor ratio - 9.4 - of the whole set, as measured by the average of fixed capital according to firm size over the average of personnel employed also by size (for the medium firms, this ratio is lower than the one for small firms; see Appendix, Table 1).

Productive Structure

Due both to the degree of concentration described and to the features inherent in the good produced, which allow multiple differentiations, the productive structure of this sector appears to have the characteristics of a differentiated oligopoly, the latter being defined as the case in which the market is shared among many firms, but where some of them control the largest proportion of production.

Although one generally speaks of the machine tools sector as a whole, the machine tools are divided, depending on the type of work they perform, into two major categories: by cutting and by deformation. Within the first category are grouped goods such as lathes, milling machines, boring machines, drills, etc. The second includes products such as presses, shears, benders, working beams, etc.

On the other hand, each good can be differentiated in terms of its size, functions, etc. The wide range of products and the diverse possibilities of manufacturing within each type of good account for the access to the market of both the small firms and the medium and large ones. They can come to the market inasmuch as their physical and technological capacities allow, producing differentiations around basic models.

The large variety of goods and the technological differentiations within them are two reasons that bring about a tacit distribution of the market among producers of the same type of good, which results in a highly imperfect market where competition does not take place through prices (within each stratum), but rather through subtle changes in design, dimensions, accessories, etc.

To illustrate these comments with a very representative case, the parallel lathes shall be analyzed*.

From the 11 manufacturers (including some distributors), according to details from the Chamber of Machine Tools and Accessories Catalog, not a single model, of those presented gather identical features, although most of them perform, in certain ranks, 

* They represented for 1971, in percent of the total of cutting tear off machine tools produced in the country, 15 percent in number of machines, 39 percent in weight and 33 percent in value.
the same functions; this implies a remarkable degree of differentiation. By plotting in a column diagram one of their determining features - the distance between centers - it may be seen that 6 of them share the rank between 2,000 and 3,000 mm and 5 the rank between 0 and 750 mm.

The most recent data obtained on total production for the sector indicate that in 1971 it reached 22 million dollars, with approximately 1,300 units. Comparing these data with those recorded in 1961 - 11 million dollars for 8,700 units - one notices that while in this period production increased by 60 percent, the value increased almost by 100 percent.

This greater value that the units of machine tools now have is due to two possible causes:

1. New types of goods have been incorporated into the universe (e.g., formerly 200 turret lathes were produced; currently production consists of 100 automatic lathes).

2. The average size, and consequently the weight and value of the machines produced, has changed.

Yet both causes imply the same, namely, the existence of a technological advancement in the machine tools industry throughout the decade studied, which is reflected in the manufacturing of machines of larger dimensions and/or operative possibilities.

**Domestic Market**

The industrial sectors demanding machine tools are so numerous that it is only feasible to make a very primary ordinal identification among the major ones; this is basically due to the lack of
information that precludes a precise quantitative analysis.

According to a recent survey which was used as a source*, 80 percent of the firms interviewed pointed to the automotive and automotive parts firms as their main consumers. Household appliances, shops, agricultural machinery, electromechanics, naval industry, railroads, etc., are located in secondary positions; as a whole, they add up to over 40 industrial sectors.

The attempt was made, in order to complete the limited information available, to resort to an approximate estimate; it involved tracing the evolution of production of the industrial sectors likely to be the main consumers and comparing them with the production series of machine tools, trying to detect a nexus between both of them.

The results obtained show that between the demand series analyzed and those of the machine tools there exists a certain coincidence in their cyclical movements, which is very significant in the case of the automotive industry and indicates a certain causal relationship between them.

Also, coincident movements are recorded with the tractors (agricultural machinery) and the durable consumption goods.

These sectors have clearly suffered a recession during 1966-67, which was received in a much more pronounced fashion by the machine tools sector. The high sensibility of the sector, during the periods when the consumers undergo crises, is understood by considering the type of production in question; it is the barometer of the cyclical movements: the first to decay and the last to recover.

When dealing with the machine tools demand in Argentina, one should keep in mind that the global demand has a dimension that is much higher than that addressed to each of the various types of machine tools in particular. This expresses itself in exceedingly reduced specific demands, and derives from the heterogeneity of the products included into the machine tools category. It is in this sense that the manufacturers of the sector refer to the limited possibilities of local substitution of some machine tools in particular, whose local market size is too limited, especially when taking into account the investments in fixed capital necessary to start production of these goods.

Exports

The exports market has been considered by most national producers as an alternative market, and at best, as a residual one.*

Historically, this has been a constant, since only when the domestic demand was in crisis (1962-1963), substantial exports were made, which reached at the time an amount of 2 million dollars (37 percent of the total production). This amount was only surpassed after 1970, although the increase did not involve the percent of the total production (see Appendix, Tables 3 and 4).

Thus, the exports during the period analyzed have remained more or less constant between 1963 and 1969, representing approximately 10 percent of the total production.

An analysis of Argentina's buyers indicates that Latin America occupies the first position - 99 percent of the exports - with a marked preponderance in Chile and Mexico. The latter country gradually acquired a greater importance in the total; its participation in Argentina's external demand rose from 18 percent in 1966 to 30

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* Data are studied starting from 1966, the year when the nomenclatures were unified according to the Brussels Treaty.
percent in 1973. Chile, on the other hand, lost participation; in 1966 it represented 37.8 percent, while only 25 percent in 1973. Brazil, which would compete with Peru for the 3rd position, represents 10 percent of Argentina's exports, with a slight growth of its participation (see Appendix, Table 5).

If one briefly pauses to study the evolution of those markets, major growth in them becomes evident, particularly in countries like Brazil and Mexico; in the 7 years of analysis, the former has quadrupled and the latter has almost doubled their total demand.

The size of these markets (Brazil had in 1973, 87 million dollars of machine tools imports and Mexico demanded in the same year other 45 million dollars) implies a voluminous potential demand to the countries selling machine tools, to which Argentina currently supplies an extremely small part (0.11 percent of the Brazilian and 2 percent of the Mexican machine tools imports).

Another interesting fact to be taken into account is the average price of the machines exported. These values differ substantially depending on the receiving countries. Thus, Mexico, or the main present buyer, purchases goods whose average value is around 500 dollars; Chile, on the other hand, is receiving Argentine machines whose average value reaches 4,000 dollars. Brazil imports from Argentina machines worth about 3,500 dollars; its technological requirements have increased during the period analyzed.

Imports

In 1961 the imports represented 69 percent of the apparent con-
consumption, fluctuating around 50% during the whole period being considered, with an average value and technological characteristics superior to those of the locally produced goods (see Appendix, Tables 6 and 7)

The automotive industry is the main importer of machine tools; according to the Custom's data, in 1973 it represented 70 percent of the total value of machine tools imports.

The remaining buyers constitute a broad spectrum of firms, belonging mainly to the following branches: automotive parts, tractors, railroad material, and several sub-branches of the steel industry. The large firms in each branch - e.g., Wobron, Dalmine Siderca, etc. - played an outstanding role.

An overall analysis of the imports for the year 1973 shows that the amount imported is around 23 million dollars and that there exists a great diversity of types of machines imported, albeit the quantities per type of machine are for the most part limited.

The average value of the imports has fluctuated during the period from 16,000 dollars in 1966 to a peak in 1972 of an average per unit value of 27,000 dollars.

The phenomenon of reduced specific demands turns up once again in the imports, although in this case it is worsened by the above mentioned fact that these demands have a relatively high technological sophistication, which limits the prospects of a subsequent substitution of these imports.

One should finally analyze the problem of custom protection, which constitutes the main concern in the Entrepreneur's Chamber claims.
In 1966 the custom tax for importing machine tools which were produced or could ever be produced locally was 175 percent of the FOB import value. This duty was successively modified until 1971, the year in which the current level of protection was instituted. The latter establishes 80 and 90 percent for imported machine tools which compete with locally manufactured ones and 5 percent - minimum duty - for those which are not produced in the country.

Unfortunately, due to the lack of information on production costs of the goods it is impossible to ascertain whether the 80 and 90 percent levels constitute an adequate protection standard. In order to make up for this lack, an attempt has been made to develop an alternative theoretical scheme.

To this end, it is first assumed that the internal price of the machine tool equals the external price of the same good plus the corresponding duties. The import exchange rate in force in that year is applied to that price X in foreign currency, in order to convert the latter into local currency.

Thus a given price $X_{t,m1}$ will be obtained.

1. $X_{t,m1} = (\text{external price}_t + \text{custom duty}_t) \cdot \text{Exchange rate}_t \cdot \text{Exchange rate}_t^t$ (where $t$ is the year considered and $m1$ the local currency).

In the following period $t + 1$, the inflation rate is applied to $X_{t,m1}$, according to the wholesale prices index (excluding agriculture and cattle). A new price $Y_{t+1}$ is thus obtained.

2. $Y_{t+1} = X_{t,m1} \cdot \text{inflation rate}_{t+1}$

This is compared with
3. \( X_{t+1}^{\text{ml}} = (\text{external price}_t + \text{custom duty}_{t+1}) \cdot \text{exchange rate}_{t+1} \)

It is observed that \( Y_{t+1} \) is greater than \( X_{t+1}^{\text{ml}} \).

This implies that under the assumption that internal price equals external price plus duties, the action of exchange rate is not sufficient to counteract the inflation rate nor, therefore, is it sufficient to match both prices.

Hence national industry would be at a disadvantage with respect to the external producer.

If the assumption is changed and now the initial internal price is 10 percent lower than the external price plus duties (keeping in mind that the external price is considered as being constant and yet inflation rates are applied to obtain the internal price, the assumption does not seem to be ungrounded), it is verified through a procedure similar to the former that the internal price, even in conjunction with the exchange rate and the inflation rate, turns out to be lower than the external price (in most of the years analyzed).

This assumption would indicate that the current protection standard would be higher than that which is necessary, that is, it fully protects national industry. This hypothesis is somehow supported by Valle's study*; working with actual data, he showed that in some cases (e.g., parallel lathes, turret lathes and working beams) the internal prices were respectively 31 percent, 18 percent and 81 percent lower than the external price plus the duties; that is, from the 90 percent of protection granted them, they

just took advantage of 59 percent, 72 percent and 9 percent respectively. This conclusion would also agree with the results of the survey, shown elsewhere in this paper, according to which the greatest percentage of those interviewed felt "adequately protected" by the tariff structure in force.

Lastly, in what concerns the origins of the imports, they come for the most part from Western Germany and the U.S., which are on the other hand the main world exporters. The remaining imports come from a few countries that also hold privileged positions in the international market: Japan, Italy, Switzerland, England and Czechoslovakia.

**Cycle**

Given the characteristics of this industry, one cannot speak of any inherent economic cycle, capable of influencing through its fluctuations the general economy - or at least its demand. Rather, it is this particular industry which has been affected the general economic cycle of the industry and subdued to the demand fluctuations. While its evolutions over time show at some points forerunners of the general recessions, this only confirms the high degree of sensitivity that this sector has with regard to the economic fluctuations, given the capital good nature of the sector's products.

In order to analyze the industry evolution over time, a series of 9 years of machine tools production was taken starting in 1960, and compared with the IGP and the manufacturing value of metal products, machinery and equipments. Thus, while the latter value grew during the period analyzed from 100 to 181, the IGP went from 100 to 168, and the supply of machine tools grew from 100 to 144, that is, more slowly than its demand (See appendix, Table 8).
To visualize more clearly the fluctuations of the machine tools production, the formula $\frac{X_t \times 100}{X_t - 1}$ was applied, which indicates the percentage variations of production in one year with respect to the former. The table of this new series (Table 9) shows very explicitly how the sector reacts to the general cyclic fluctuations of the economy, having variations of increase and decrease remarkably superior to the other series dealt with. While the production value growth rates of metal products, machineries and equipment had during the period a maximum of 30 percent, the machine tools, on the other hand, had a growth rate of 59 percent; when the growth rates became negative for the two first series, around 9 percent and 6 percent respectively, the machine tools fell around 49 percent, and the reaction among them was more pronounced in the cutting machines than in the deformation ones.

As a result of the continuous demand fluctuations that the machine tools industry must bear, with increasing difficulties in their production programs, reinvestment, finances, etc., a peculiar entrepreneurial behaviour has come about, characterized by the limited expansion of the supply reproductive capacity. Furthermore, most firms work only a single shift employing in almost all cases a surplus of after hours, but which does not get to exceed 40 percent of a shift, even when they have orders of up to 6 production months*.

This behaviour is also ascertained in the low specialization of the firms, demonstrated by the fact that 45 percent of the sector's establishments develop other secondary activities alien to machine tools - although within the same metallurgical branch.

* Data from our survey.
Production

The machine tools production during the period analyzed - 1961-1971 - denotes a twofold evolution. On the one hand, one notes a change in the relative participation of certain goods within the whole produced, and on the other, one observes a greater technological sophistication in their manufacturing *.

This conclusion is arrived at from the analysis of the following data: the increase in the number of deformation machines manufactured - 82 percent - is higher than the increase recorded in the cutting machines (30 percent).

The latter group, which in 1960 represented 80 percent of the total of machine tools produced, gradually loses participation in the total, and in 1970 it represents 70 percent of the total (see Appendix, Table 2).

Likewise, in absolute terms, the increase in the value for deformation machines (158 percent) is greater than that for the cutting machines, which was 91 percent (see Appendix, Table 3).

However, if the increase in the value is compared with reference to the increase in the quantity of units produced within each particular group, one notes that while in the cutting machine tools the value index increases in a proportion three and a half times higher than the one of production, in the deformation machines the value index is only doubled with respect to the one of production. This implies that while it is true that the cutting machines have apparently lost relative weight within the whole of machine tools manufactured domestically, on the other hand they have gained importance through the greater value incorporated into them. This would point to this group as the

* DGFM sectorial survey.
one with greater advancements in technological innovations.

3. **Technology**

**Human Resources**

The following structure of utilization of trained human resources became apparent from the survey undertaken:

<table>
<thead>
<tr>
<th>Number of Engineers</th>
<th>Number of Firms</th>
<th>Number of Technicians</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
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</tr>
<tr>
<td>5</td>
<td>1</td>
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<td>3</td>
</tr>
<tr>
<td>+5</td>
<td>0</td>
<td>+5</td>
<td>5</td>
</tr>
</tbody>
</table>

The combination of technicians and engineers within firms was:

<table>
<thead>
<tr>
<th>Techs.</th>
<th>00</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>+5</td>
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</tbody>
</table>
Approaching the matter from the viewpoint of Sabato et al.*, one may assume that the existence of at least 1 (one) engineer in the firm implies the possibility of reading, knowing and interpreting technology with a scientific basis. Under these conditions, 40 percent of the firms surveyed would not be in the position to assimilate such type of knowledge and incorporate it into their technological evolution**. These remarks, at least in the specific case of machine tools, must be pondered in view of the direct observations done on the type of activities in which the engineers are employed. It is the team's impression that there are no more than 6 (six) firms, among those surveyed, in which there are what might be called "white collar engineers", that is, professionals whose immediate concerns (and even the physical working setting) are outside the everyday production problems, e.g., in a production and design department. In the remaining firms, the engineers perform roles related to problems which range from financial and commercial ones, to quality control and collaboration in machine maintenance.

The relevance of this observation is that either of these types of occupations conditions the creative possibilities inherent in the professional's function; that, according to the foregoing, could be in the position to become the vehicle of assimilation of knowledge of scientific basis in the productive unit.

The Technological Evolution of the Sector

The technological history of the machine tools sector in Argen-

** Concerning this point, the reader should be reminded that although the sample covered 25 percent of the universe in number of firms, it comprised 75 percent in production value; hence it is very probable that in the remaining firms the percent of qualified personnel is even lower.
tina can be summarized in 3 stages which are not separated by sharp time limits, nor have they been necessarily passed by all firms.

The first stage can be defined as the one in which the "primary" types of machine tools manufactured in the country, appeared: lathes, milling machines, boring machines, working beams, etc. This stage starts in Argentina with the birth of the activity at the beginning of the century and may be considered as exhausted at the end of the 50's, when the spectrum is virtually covered.

The second stage may be called the "diversification" one, and is characterized by the advent of diverse models starting from the basic types; they are differentiated among them in terms of their power, weight, speed, the addition of accessories which increase the operative possibilities, and the addition of modifications or minor "improvements" that - basically - make the machine operation easier. The modifications in the electrical, lubrication and cooling systems, and the addition of brakes, clutches, etc., are included here.

In most cases, the technology involved in this stage was obtained through copy. Starting both from direct observation and the disassembly of imported machines, and even from leaflets and catalogs, the manufacturers of the sector, showing a great mechanical skill, were producing and constantly diversifying their machines, with a high "trial and error" content in the process. If the type of technology used in this stage, in which one finds most firms, had to be characterized, one would say it
is predominantly an artisan technology*.

These observations are coherent with the characteristics of the scarce existence and utilization of human resources of university and technical level, which is referred to in previous pages.

The incorporation of technological advancements that significantly improved the precision and durability features of the machines in this second stage was performed at a speed sensibly lower than the diversification of models and sizes, and the incorporation of accessories.

The diffusion of such advancements has remained limited to a reduced number of firms, some of which subsequently passed to what is denominated the third stage.

In order to try to confirm this hypothesis, those technological advancements have been listed, specifying the year of their introduction, the innovating firms, and those which are currently using it.

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* Different categories can be used to explain the sense of the concept "artisan", which is here applied to the sector's technology. A first group refers to the origin of the knowledge used in the productive process and the method employed for its incorporation. In this sense, "artisan" technology would be characterized by the fact that it starts from invention based on experience or on the "general principles of mechanics". The process of incorporation and subsequent modifications is unsystematically performed by trial and error, with little accumulation of experience. From a different standpoint, adopted by Charles Perrow to analyze the relationship technology-structure, artisan technology is defined as that characterized by: a) few exceptions in the type of stimuli that the production process sends to the agents of its realization; b) non-analyzable search for the responses to those stimuli; that is, the search for the response occurs without being able to resort to a basis which would allow to analyze and standardize the situation.
<table>
<thead>
<tr>
<th>Year</th>
<th>Innovating Firms</th>
<th>Innovation</th>
<th>Firms currently using it</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>A</td>
<td>Aging of the foundries</td>
<td>A-B</td>
</tr>
<tr>
<td>1958</td>
<td>A-D-E</td>
<td>Gearings produced by profile generating methods</td>
<td>A-B-C-D-E</td>
</tr>
<tr>
<td>1958</td>
<td>A-D</td>
<td>Thermally treated gearings</td>
<td>A-D-G</td>
</tr>
<tr>
<td>1958</td>
<td>A</td>
<td>High precision, adjustable cylindrical roller bearings</td>
<td>A</td>
</tr>
<tr>
<td>1960</td>
<td>A</td>
<td>Tempering and rectification of bedframes</td>
<td>A-B-C</td>
</tr>
<tr>
<td>1960</td>
<td>A</td>
<td>Temperable, pearlitic foundry</td>
<td>A</td>
</tr>
<tr>
<td>1960</td>
<td>A</td>
<td>Use of high precision roller bearings</td>
<td>A-B-C</td>
</tr>
<tr>
<td>1960</td>
<td>D</td>
<td>Adjustable nuts with balancing and elimination of clearance</td>
<td>A-F-C-H</td>
</tr>
<tr>
<td>1962</td>
<td>I</td>
<td>Pneumatic drive couplings</td>
<td>I Several</td>
</tr>
<tr>
<td>1962</td>
<td>J</td>
<td>Electropneumatic drive couplings</td>
<td>I-J-K Several</td>
</tr>
<tr>
<td>1964</td>
<td>K</td>
<td>Electropneumatic clutches and brakes</td>
<td>Several</td>
</tr>
<tr>
<td>1965</td>
<td>A</td>
<td>Development of copying hydraulics</td>
<td>Several</td>
</tr>
<tr>
<td>1965</td>
<td>C</td>
<td>Systems of lubrication and friction elimination by oil fog and cushion</td>
<td>C</td>
</tr>
<tr>
<td>1965</td>
<td>A</td>
<td>Reversing slotted shafts thermically treated and with rectified slots</td>
<td>A-D</td>
</tr>
<tr>
<td>1965</td>
<td>A</td>
<td>In high production lathes, bedframe developed on vertical or sloped plane to facilitate cuttings evacuation</td>
<td>A</td>
</tr>
<tr>
<td>1965</td>
<td>A</td>
<td>Adjustable nuts with constant tension</td>
<td>A-D-C</td>
</tr>
<tr>
<td>1966</td>
<td>A</td>
<td>Forged gearings</td>
<td>A</td>
</tr>
<tr>
<td>1967</td>
<td>C</td>
<td>Lubrication by oil fog in closed milieu</td>
<td>C</td>
</tr>
<tr>
<td>1967</td>
<td>A</td>
<td>Forged and thermally treated spindles</td>
<td>A</td>
</tr>
<tr>
<td>1968</td>
<td>C</td>
<td>Use of self-braking motors</td>
<td>C</td>
</tr>
<tr>
<td>1969</td>
<td>C</td>
<td>Use of preloaded bearings</td>
<td>C</td>
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<tr>
<td>1970</td>
<td>A</td>
<td>Demountable guides of tempered and rectified steel</td>
<td>A</td>
</tr>
<tr>
<td>1970</td>
<td>A-C</td>
<td>Frequent use of preadjusted tools</td>
<td>A-C</td>
</tr>
<tr>
<td>1971</td>
<td>C</td>
<td>Lubrication by oil fog in leakproof milieu, with recirculation</td>
<td>C</td>
</tr>
<tr>
<td>1971</td>
<td>L</td>
<td>Hydropneumatic drive coupling</td>
<td>L</td>
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</tbody>
</table>
The characteristics of the firms that have adopted the advancements mentioned here, i.e., large firms whose production represents a very important percentage of the total value, although reduced in number of machines, leads one to think that such advancements have been incorporated only into the greater value machines, particularly those produced by 3 firms (A,B,C), while the bulk of national production is undertaken without these features.

The third stage, determined by the progressive evolution of the technological requirements of the automotive industry, is characterized by three types of elements: a) the development of transfer and special machines that require a strong component of engineering creation, due to the specificity of the operations performed by each machine, as well as the precision requirements involved; b) the advent of certain types of machines designed to perform works on large size pieces with great versatility and precision; c) the advent of machines equipped with partial and total automation schemes, and/or electronic instruments of measurement and control.

The gathering of machines with these three features in the same stage is due to the fact that all of them involve:

1st A structure of creation and production that surpasses the artisan peculiarities of the vast majority of industry: engineers, updated technological information, precision control instruments;

2nd the entry of the machine tools Argentine industry - though with a considerable time lag - in the predominant trends in countries with greater industrial development.

The advent of the machines included in this third stage comes
about at different times. The special and transfer machines appeared during the first half of the 60's, with the birth of the automotive industry; they had great difficulties at the beginning, although because of the demand of the large automotive firms they increased quickly. The second type of machines appeared during the latter 5 years, its ultimate expression being a production drill with 130 mm spindle (exhibited in the Sixth EMHA* AMTE). The third type of machines, particularly electronic instruments of measurement and control, are just beginning to show their possibilities in the market. The Sixth EMHA shows the timid presence of two manufacturers who, in a process of evolution towards integral automation schemes through numerical control, exhibited digital control devices, with good acceptance on the part of most manufacturers, which certainly will modify the technological evolution patterns of the sector.

The firms that have come into this third stage show a greater technological potential than those locked by their present fulfillments that stem from the observation of their project offices, quality control departments, and the technological evolution process during recent years. Limited by market considerations, even a company that is leading the sector but is part of a wider whole which includes distribution and fears about the future continuity of the firm, has progressed considerably less than its equipment and human capability would have allowed. The data on the evolution of imports during recent years clearly show how the sector has been gradually falling behind the requirements of the most sophisticated demand.

**Technological Support for the Sector**

The technological evolution of the firms seems to be dependent al-

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* Argentine Machine Tools Exposition.
most exclusively on their own capacity. In other words, we have not detected the relevant participation of people or agencies outside the firms who had supported their technological evolution.

From the 23 firms surveyed, 17 (74 percent) never resorted to external consultants for the resolution of their technical problems. The 6 remaining ones do it only sporadically.

Concerning the State institutions that might have the mission of providing technological support for the sector, only the National Institute of Industrial Technology (INTI) can be mentioned. Eight of the firms surveyed stated they had on some occasion resorted to it. Those 8 firms resorted to the INTI only to order tests of materials and measurements, and in no case did it to request technological information or support for designs, projects, problems in the machine operation, etc.

The results of the relationship of these entrepreneurs with the Institute were in their judgement "negative" or "discouraging" due both to the delays in performing the jobs requested and to what the respondents judged as "excessive price", as compared with that charged by private test laboratories.

In the course of an exploratory survey on research institutions whose activities might be considered of current or potential interest to the technological development of the sector, three institutions that develop programs under such conditions have been detected.

Department of Applied Electronics, National Observatory of Cosmic Physics, San Miguel, Buenos Aires Province. This group is working on the development of an electronic system for information collection and processing with the ultimate goal of
arriving at a numerical control system to be applied to machine tools. Up to the present, they have completed a digital positioner for one axis and are about to finish one for three axes; they have a top rank team of researchers and a clear research program with defined goals. The work of this group must have developed absolutely disconnected from the manufacturers of the sector, who have not shown any personal or institutional interest in its activities, nor in the positive potential of its investigations.

- Electronic Materials, Components and Systems Sector of the INTI. Within this institution, the Electronic Systems sub-program runs four projects; among these, the one of interest to our subject is on the realization of a series of instrumentation modules for the conditioning of analogic signals arising from industrial processes in general. According to the heads of the project, the current usefulness of the ongoing programs is relative, although the characteristics of the topic permit to foresee in a near future an accumulation of knowledge that can be readily transferred to areas linked to the automation processes of machine tools.

- Materials and Technology Department, School of Exact, Physical and Natural Sciences, National University of Cordoba. The programs developed in this Department that are potentially useful for machine tools are:

a. "Method for the evaluation of the 'machineability' in steel and foundries". It is a testing technique, specially relevant to metalmechanic industries, confronting the problem of machine building from difficult and/or large series materials.

b. The second program attempts to study new developments in cut-
ting tools and to induce their incorporation in industry. The first stage of studies comprises the analysis of new geometries for helicoidal drills. The future development of this program is jeopardized by financial problems in the institution.

As it can be noted, there exists a primary human and institutional basis which allows the generation of useful knowledge for the productive and technological evolution of Argentine's machine tools. However, considering the nature of the subjects developed in two of the cases (electronic components), and taking also into account the characteristics of the specialized human resources existing in most of the industries surveyed, our first impression is that an important transformation is needed in those human resources, particularly in the entrepreneur's behaviour, not only to generate an effective demand for such knowledge, but also to reach a stage where the firms would incorporate the latter to their products and manufacturing processes.

Finally, and according to the evidence stemming from this investigation, unincorporated and contractually acquired foreign technology has not represented an important element in the technological evolution of the sector. Only 6 of the firms in the whole sector operate under foreign licenses, but in just two of the cases the machines produced on the basis of those licenses represent an important percentage of the respective firms' invoicing. If, on the other hand, foreign technology acquired through the copy is considered, one finds that its contribution to the development of local production has been fundamental.

In summary, the lacks referred to above in applied research, development, transfer and general technological support for the sector, lead to a situation determined by each firm's capacity to
rely on its own team of professionals or attaining through other means the technological support necessary for its evolution. But also, those lacks imply the absence of a supporting environment favorable to the individual efforts towards technological development.

**Technological Information**

There are not at present any formal mechanisms of diffusion of technological information for the sector. There are no data files, technical information systems, or an institution that would regularly furnish elements which might be used by the manufacturers.

National magazines do not provide technological information, except in the few cases in which translations from foreign sources are offered. The whole sample classed them as being of "commercial interest only", which can on the other hand be ascertained through a rapid scanning of the literature.

Foreign magazines, both due to language problems and the level of specialization required to profit from reading many of their articles, are within the reach of just a slight percentage of the firms.

The expositions, particularly the foreign ones, are the main vehicles through which the entrepreneurs may get acquainted with technological advancements and innovations that may be incorporated into their own machines, in accordance with the patterns of technology incorporation dealt with elsewhere. Ninety-one percent of the sample stated that they normally attend all national expositions, while 78 percent of them visit international ones with a remarkable frequency, considering that within this figure
are included firms of small size and financial power. Some of the most important firms send to European and U.S. expositions not only their directors, but also production engineers and people in charge of technical departments. The Argentine Chamber of Machine Tools Manufacturers does not have a specialized library, nor does it offer technical information services, translations, etc.

One exception to this state of "helplessness" in which the firms of the sector find themselves is the group settled in San Francisco City*, thanks to the activities that - still in their inception - are developed by the Industrial Park and the Metallurgical Industry Association. The entrepreneurs interviewed in that city, including a very small one, expressed they attend the technical lectures given at the headquarters of those institutions, and rated them as being very useful. Likewise, the mere presence in the Park of engineers, who can be easily consulted, has been creating in the entrepreneurs the "consulting habit", which stimulates in turn a greater reflection on their own problems and the possibility of applying the solutions.

The survey included a question on the type of support the entrepreneurs would expect from an agency such as the projected Argentine Center for the Machine Tool, which would operate within the INTI. One-hundred percent of the answers were information on: a) possible trends for local technological development; b) the technological implications of starting more sophisticated products; c) the local and external market possibilities for new products.

The evidence gathered indicates the existence in the sector of a real avidity of information, whose lack seems to be one of the key elements to understand its criteria of technological behaviour.

* See Appendix 2.
Confronting a highly concentrated demand, whose patterns of technological evolution cannot be influenced by the entrepreneurs, and an external market unknown in terms of their projections and competitiveness characteristics, and given the technological implications of starting more sophisticated products, the lack of information implies a risk that, except in the cases of greater financial strength, the entrepreneurs are not willing to take.

It is interesting to note in this regard that the firms that are directly linked to distributors, which allows them to have available reliable information on the technological and commercial trends, are the ones that have followed defined expansion plans, progressively winning important portions of the local and external market.

In view of this need of information, the government's instruments of financial fiscal, and tariff promotion seem to become relative in terms of their effects, since they do not necessarily diminish the risk of innovation which is ultimately taken by the firms. The lack of information on the technological alternatives would thus limit the firm's decisions before the benefits offered by the instruments could be taken into account.

Circulation and Appropriability of the Technology

The characteristics of the technological evolution of the sector during what has been called "second state" - in which one finds most of the firms - can be directly related to the broad circulation of the technology incorporated in the machines, and their consequently low degree of appropriability.

The history of the Machine Tools Expositions, which are organized every 2 years starting 12 years ago, shows the speed with
which the minor innovations or "improvements" introduced by the manufacturers in their machines are diffused. Given the nature of the latter, direct observation and mechanic skill permit their easy incorporation.

In accordance with the latter, all the entrepreneurs agreed on the relative possibility of obtaining an exclusive exploitation of the improvements they achieved in their machines, questioning the usefulness of the patents as a protection system. In this regard, it can be mentioned that only 8 of the 23 firms have registered patents. This fact may in principle be interpreted as resulting from the combination of the artisan nature of the "improvements", and the scarce confidence the entrepreneurs have in such a protection system.

The observations above may explain the reluctance shown by many entrepreneurs interviewed to offer information on the technological developments "in folder". If the degree of appropriability of the technological advancements is too low, the entrepreneurs are likely to rely on the surprise factor to increase the period of primacy in the market of their new products or modifications. The reluctance appeared specially for entrepreneurs who were studying diverse automation mechanisms of their machines, as well as the incorporation of electronic elements of measurement and control.

**Quality Control**

One of the most remarkable lacks concerning the technological structure of the sector is the equipment for quality control existing in the firms. Only 3 of the 23 firms visited have equipment above the acceptable level. In one case, the firm which is perhaps the leader of the sector, has a top level facility installed, with sophisticated equipment, specialized personnel, and a control rou-
tine which covers virtually 100 percent of the pieces incorporated to the machines. In the second firm qualified in this respect a department is being organized, with somewhat obsolete equipment, but with a fairly strict control of the pieces in process and the final product. The third firm is a small one, producing special machines, which has recently purchased a very high precision electronic machine, the only one in the country, which guarantees a rigorous control of all of the components.

The remaining firms surveyed show all kinds of deficiencies in this field, both in their equipment and in the verification procedures used, which result in the lack of integration of the quality control in the whole process of machine production.

These observations are specially relevant, since the survey was made after a sustained expansion of the sector - lasting over 2 years - with highly favourable prices, in spite of which there is no tendency on the entrepreneurs' part to allocate a portion of the surplus obtained to improvements in their quality control systems.

The lack is not compensated for by State institutions - such as the INTI -, as it may be inferred from the entrepreneur's responses; in the majority of the cases, they had negative experiences whenever they resorted to it.

Parts and Accessories Producing Industries

As part of the analysis, 5 manufacturers of parts and accessories for the sector were interviewed; 2 in the area of hydraulic and pneumatic elements; one manufacturer of cutting tools; one manufacturer of electrical elements; and one manufacturer of electronic systems for measurement and control. Despite the diversity
of technological fields covered, it is our belief that the conclusions can be applied to the whole sample.

A report by E. Sabatte, written in 1972, highlighted the appreciable progress observable in these industries, starting in 1968, and the consequent important role played by them in the machine tools terminals. The present report leads to the same conclusions, which are based on the elements described next*.

A peculiar technological dynamism has been detected - measured by the advent of new products and their importance - in all of the firms interviewed. In all of the cases new products had been recently put in the market and/or were in the experimental stage. The number of technicians in relation to workers - in four of the five firms - is higher than the machine tools sector average. In the remaining firm, although that average is lower, there are high precision control instruments.

All of the firms expressed that their production exceeded the requirements of the national machine tools producing sector. The possible explanation of this fact is that the procedure of parts find themselves in an accelerated imports substitution process, either for production of formerly imported elements, or for the replacements of parts and accessories of highly sophisticated machine tools. The latter is clearly the case of the cutting tools manufacturers.

With a single exception, the firms interviewed have sales organizations employing predominately specialized technicians whose function is - in their own words -**.

* Similar conclusions are reported by F. Vidossich. (see bibliography).
** "To detect needs, transform them into our technological language, solve them, and then go into commercial development".
A good deal of the technological dynamism being referred to, may be accounted for by the competition existing among parts and accessories producers. Sixty-one percent of the machine tools manufacturers stated they were satisfied as regards the quality of those components, attributing this fact to having been able to perform a selection process among the numerous existing manufacturers.

For all the manufacturers of parts and accessories interviewed - with the sole exception of the cutting tools producer - the sales to the machine tools sector represents a percentage of their invoicing which in no case exceeds 40 percent, and the bulk of their production is aimed at sectors with well defined and constantly evolving technological requirements, such as motor vehicles. This determines the fact that the machine tools sector, given its size and other characteristics referred to throughout this report, is not in itself an inductor of technical change in parts and accessories, but rather a "passive" beneficiary of the advancements generated to be utilized in other sectors.

The latter observation might account for the characteristics of the technological evolution at what has been called the "second stage", in which one of the dominant elements is the incorporation of parts and accessories to the machine tools basic structures.

During the visit to parts and accessories factories, an "integration surplus" could be observed, determined by the existence of highly sophisticated production and control machines, with a low degree of utilization. This can be explained by the following reasons: a) the need to have those machines available so as to maintain the rhythm imposed by the competition and the requirements of the terminal industries; b) the absolute lack of exter-
nal technological support—particularly in measurements instruments—which could be resorted to, instead of making the high investments involved in their individual acquisition.

To summarize, it is our impression that the role of the industry producing parts and accessories for machine tools has turned out to be the major determinant of the technological evolution characteristics of the latter, which became a passive beneficiary of the developments demanded by other sectors. If the machine tools sector starts producing highly sophisticated machines with total automation, the requirements imposed by this new stage—as it can already be observed in the case of some special machines—will cause the machine tools manufacturers to become active agents for the technological development of parts and accessories.

**Norns**

The catalogs of IRAM* record 26 norms referring to machine tools, their parts and accessories, out of over 3,600 norms elaborated by the Institute. The totality of the norms mentioned refer to cutting machine tools and may be classified in the following manner:

**Machine Tools**

- Nomenclature and reception conditions of machine tools: 3 (year 1955).
- Geometrical verification and practical testing of machines: 6 (1965-73).

* IRAM is a private institution, in charge of the setting of industrial norms and standards in the country.
Accessories

- Dimensional normalizing of various accessories: 13 (year 1971-73).

From the interviews with IRAM personnel, it was discovered that these norms were not developed under the initiative of the Chamber of Manufacturers of the sector, but by decision of the IRAM Institute itself.

This Institute grants those firms which guarantee a production in total accordance with its norms, a "seal of conformity". No firm of the sector receives this seal.

From the survey of the firms, the following data came forth: in general, it is observed what might be called a situation of "anarchy" with respect to standards. There is no defined trend in the utilization of norms: some firms use DIN, others use IRAM, others use Schlessinger (4 firms), while still others combine those norms with their own reference.

Only one of the firms interviewed delivers with each machine the card that attests its performance in relation to the norm, as a guarantee of the product's quality.

4. Management

The subject of management, as it related to the problems of technological development at the firm level, has been scarcely dealt with in the literature of the Third World countries. In this respect, the most recent example, as far as it could be determined, is the work by Sabato, Carranza y Gargiulo*, in which

several valuable conclusions are drawn.

Recently, Suarez and Feldman have published a book in which, pointing to a future research work, a methodological approach is developed on the subject of administrative technologies, preceded by an analysis of the most relevant authors dealing with that subject*.

These two earlier works have contributed to the study of the subject carried out in the present research: the basic conceptual elements have been drawn from Suarez and Feldman, and were enriched through personal contacts with the authors.

The central idea in the team's approach has been to study the central technologies and the management technologies (both are generically termed "Organizational Technologies" by Suarez and Feldman), as elements which are necessarily concurrent with the harmonious economic-technological development of the machine tools manufacturing firms.

In order to identify more sharply the object of analysis, some of the definitions developed by Suarez and Feldman will be presented.

Management Technology: "Usable or used knowledge that operating in administrative technological areas transform through successive elaborations some symbols into others, with the aim of developing the basic processes of the administrative activity in organization".

Administrative Technological Area: "That differentiated set of administrative technologies used by the organizations for the at-

tainment of certain functional goals, defined in accordance with a given horizontal division of the organizational work". According to these authors, "within each technological area it is possible to detect sub-areas and within them, in turn, a given quantity of technologies". Examples of such areas are finances, purchases, sales, planning and control of production, etc.; in the present survey, an attempt was made to obtain information on those areas.

Once the object of study is defined, an attempt will be made to explain the reasons (or relevancy) for its study, with reference to the objective of the present project.

Perhaps the author who comes closer to the idea which seems to be relevant in this respect is James Thompson, analyzed by Suarez and Feldman. The predominant concept in Thompson's analysis is "protection", which derives from the consideration that adequate central (or engineering) technologies do not per se assure the attainment of the goals of the economic unity. Thompson states: "Technical rationality is a necessary but never a sufficient component to provide organizational rationality, which includes the acquisition of the inputs implied by the technology and the distribution of the products which flow from the technical domain"; in other words, an economically optimum functioning of the central technologies.

Thus, an adequate management may surpass the "support" level, to become a "condition". In their work, Sabato et.al. show in the case of ferrous foundry how an inadequate handling of management technologies may become a determinant of the failure to exploit the economic possibilities offered by an advanced central techno-

These concepts are specially relevant to those cases in which the organizations operate in unstable contexts. In such cases, Thompson points out that management technology may serve to level the inputs and products operations.

The Machine Tools Sector

The sector under study presents certain specifics that, in relation to the scheme proposed above, are worth considering, since they condition the characteristics of the management technology to be used.

Above all, and as it may be seen elsewhere in this report, one is dealing with a sector that has not surpassed the process of imports substitution and whose evolution, both technological and economic, depends on its capacity to displace foreign products, to strengthen itself in the positions achieved, and eventually broaden itself through exports. This makes it very dependent on the protection that the State might offer it, without which, for lack of a solid structure of its own, many firms would disappear. The type of product manufactured - capital good - "inherently" has a highly unstable demand, and hence requires that the producing firms handle it in relation to the environment that enables them to diminish the impact of rough fluctuations, like the ones which occurred in the past, in the face of which they are in a position of seemingly mere passive receptors.

Finally, the size of the firms is a determining factor. In absolute terms, the small and medium firms lack a solid background and financial basis, particularly with respect to the de-
mand fluctuations.

In relative terms, the small size and the consequent reduced volume of demand generated by those firms, places them in a marginal position vis-à-vis the suppliers of certain vital inputs (e.g. foundry), and even with respect to the market of the skilled labor force, for which there exists competition against sectors with greater remunerating possibilities than the machine tools one.

Starting from these characteristics inherent in the machine tools sector, and as a function of the theoretical scheme set forth at the beginning, the attempt will be made to draw conclusions about the way in which the handling of management in the firms surveyed may condition their general development.

The survey, in what concerns the areas of administrative technology, was designed to know the way in which the different functions are handled, which implies: a) their degree of differentiation within the firm's structure; b) the characteristics of the human resources assigned to them; c) the degree of formalization with which the subjects inherent in the area are developed (particularly planning and execution).

Sales

The first relevant element concerning the sales function is to determine the percentage of total sales which is channeled through distributors. The data obtained by the FM study yield the following results, in percent of total sales of the sector, for 1971:

- direct sales by the manufacturers: 44.7%
- sales through distributors : 55.3%
In order to measure the organization of the sales structure and its differentiation, it is assumed that this function may be considered as being differentiated whenever there exists a professionalized structure whose exclusive function is to devote itself to handling the firm's sales. This leads one to include within such category not only those firms having a sales managership, but also the ones which sell their products through distributors, which thus covers the sales function externally*.

The results were the following:

Differentiated : 12 (50%), 7 of which sell through distributor; hence only 5 have a sales managership.

Undifferentiated : 11 (50%) firms in which the sales function is handled by one person who also performs other functions (purchases, financial, etc.)

Out of the 7 firms selling through distributors, only 4 do it through exclusive distributors. The importance of this point lies in the fact that the distributors absorb the cyclic demand drops (by accumulating stocks), but only with the firms of which they are exclusive distributors. Thus, there are 3 firms that in the event of important drops in the demand may become disarmed and without a sales structure of their own.

* The estimates of the present sample are in agreement for 1975. The importance of this piece of data - which will be further dealt with below - lies in the fact that the distributors of national machine tools are at the same time importers of foreign machine tools, which places them in a position such that they must evaluate the advantages of a greater imports substitution, with the decrease of their profits as importers. As an example, one might mention that three of the leading firms of the sector are directly dependent on the most prominent importer of machine tools, a firm owned by Swiss capitals.
Out of the 12 firms that in this survey sell their production directly, half of them (6) do it "over the counter", that is, they do not employ one or more salesmen searching for clients; they just passively face the demand.

Only 2 of the firms from the whole sample have technicians in their staff of salesmen; in the remaining firms one finds "professional salesmen" with a long experience in the branch.

To sum up:

- Direct sale by the firm: 12
  . Over the counter: 6
  . With salesmen: 6
  . Technicians: 2
- Sales through distributors: 7
- Both channels: 4

Differentiation of the function
Differentiated: 12

- Sales with distributor: 7
- Item exclusive: 4
- Internal differentiation of the function: 5

Fifty percent of the firms of the sample make estimates on future sales. The rest structure their production according to the orders, with a prospect no longer than 3 months.

One should finally mention that 70 percent of the firms interviewed stated they had their own after-sales technical service, which in most cases just consists in visits when flaws come up. Only one of the firms interviewed offers a service of periodical visits to customers. The rest of the firms that do not have their
own after-sales service, commit it to the distributor's care.

In addition to the evidence stemming from the figures, the interviews offered some elements which allow to assess the importance of the sales function in the conjuncture. Our impression in this regard is that the general expansion (January 1975), observed at the time of the survey, and the consequent easiness with which the products were placed in the market, have led the entrepreneurs to feel to a certain extent unconcerned about the conquest of new markets or the enlargement of the present ones. In fact, several respondents made explicit their lack of interest in an important expansion which might have long-term financial implications. In some cases, statements were made such as the following: "Having salesman does not favor me, for I would acquire commitments I would not be able to meet".

In several of the firms surveyed, the lack of concern about this function is likely to be due to the "easy" market position they hold, as was pointed out elsewhere.

The deficiencies in the differentiation of the function, personnel specialization and sales planning, imply that in the event of significant drops in the demand, an important part of the sector will not be prepared to take on an active position capable of softening the negative impact.

The importance of an adequate capacity to influence the market on the part of the machine tools manufacturers is due to the fact that the demand of these products is not a flow, but rather a stock, which would be quickly saturated in the event that the environmental conditions become unfavorable to the investment. In such cases, the demand is restricted to that originating in the replacement needs due to physical obsolescence. Only with an
adequate commercialization scheme it can be attempted to: a) force the economic obsolescence of the existing machine tools by means of the differentiation of products; b) detect and fulfill the requirements of new uses for the machine tools.

Particularly in the case of the small firms, in which the amount of investments in fixed capital and the voluminous requirements of the immobilization of inputs create unstable financial situations, an extended drop in the sales may seriously affect their survival, as it has already occurred at the beginning of the 60's.

**Finances**

The survey was conducted during a period of unusual financial relief for the firms of all sizes. The excess of demand with respect to the possibilities of the supply led to a restriction in the granting of credit, which during periods of lesser prosperity even the small firms were forced to offer. The most extended credit terms that were detected in a few cases exceed 6 months, although with the requirement of strong advance payments; there are even firms that sell exclusively for cash.

Even though the firms of the sample regularly resort to the Commercial Bank's credit of evolution (with the exception of 3 firms which are self-financing and one which finances itself through its suppliers), a considerable percentage of their surplus is allotted to the accumulation of raw materials and - during periods of expansion such as the present one - the enlargement of their physical facilities.

The degree of differentiation of the function is as low as in other administrative areas: only 4 of the firms have their own
financial manager; 3 other firms have the support of part-time accountants who, along with other functions of an administrative nature (taxes, costs, liquidations), act as consultants on financial problems.

Only 9 out of the 23 firms interviewed develop financial budgets, with prospectives which range from 3 months to one year. Among the firms that do not develop them, there are some with invoicing levels above 5 million "pesos ley" per year.

The low coefficient of capital rotation, which increases with the size of the machine manufactured, the vital role played by the availability of inputs, and the high relative value that the capital goods used in the productive process has for many firms made the financial area a central aspect for the survival and expansion of the sector's firm. The uncertainty with respect to the acceptance of a new machine by the market, the danger implied in long periods of capital immobilization, and the impossibility to have at the firm's disposal risk capital, are some of the factors which have been referred to in the relevant section.

Some credit instruments designed to lower the financial costs of innovation had - as it was mentioned in the concrete analysis of each one of them - absolutely no effect whatsoever on innovating behaviour, and this is true even for the most dynamic firms. Besides the inherent deficiencies in their mode of application pointed out here, the limited credit amounts, which have been frozen for years, renders them even more useless.

Purchases

As it might be expected as a function of the characteristics of the sector and the firms referred to above, the purchases function is taken care of with greater dedication than most of the
rest. Although just 50 percent of the firms has one or more persons specifically devoted to the purchases function, in 70 percent of the cases the future needs are— with greater or lesser formality— planned.

The most remarkable differences between large and small firms involve the methods of planning used (control of minimum stocks - general and by operation — versus "visual control"), and the time prospective of the purchases plan (from 1 year to 2 or 3 months). It would thus seem that the firms are aware of the need to always have additional stock available so as to assure that the production flow is not upset.

With the exception of the case of the 5 largest firms of the sample, purchasing structure could not be found that was capable of selecting and technically interacting with the suppliers. It seems, rather, that the incorporation of the advancements generated by the industry producing parts and accessories has taken place through the work of the sales teams of those manufacturers, among whom a strong competition has been detected.

A good deal of the needs of information on technical advancements suitable for incorporation into the national machine tools, which should actually be covered by those in charge of purchases in the firms themselves, are far beyond the possibilities of the small and medium firms of the sector; hence, in this area, external support is fundamental if a greater possibility of access to the information is to be assured.

**Personnel**

As far as this aspect is concerned, the survey was designed to inquire about the restrictions that the lack of specialized
personnel might imply for the normal evolution of the firms. The evidence gathered was conclusive: with the single exception of two firms, settled in San Francisco, all of the firms admitted that the lack of specialized personnel - particularly machine operators - is one of the most important obstacles to the expansion that at the time characterized the sector. It was verified in this respect that numerous firms had machines that were not in use due to the lack of trained personnel.

Entrepreneurs in general are reluctant to train their personnel from the apprenticeship level, and prefer instead to recruit trained operators. The most common recruitment method is the "newspaper"*, followed by the "transfer" of personnel from other plants, induced by better remunerations or other extra benefits.

There is not any formal connection between the firms and the National Council of Technical Education (CONET). In the few cases in which the entrepreneurs have recruited personnel from technical schools it has been on the basis of personal contacts. The most common criticism the entrepreneurs make of the CONET's function refers to its emphasis on the training of "technicians", instead of providing workers (lathe and milling machine operators, etc.), which constitute the bulk of the sector's demand.

Our impression on the problem of labor as it relates to machine tools is that - during periods of expansion such as the one which was taking place during the survey - the sector's manufacturers cannot attract the skilled labor force in the market; due to their limited capability for competing with the remunerations offered

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* Some of the firms interviewed had a charge account in the newspapers for the search of personnel.
by the large automotive and metal-mechanic firms in general. Furthermore, the reduced average size of the firms makes them dependent upon the external supply of qualified labor (CONET), since in most cases they cannot afford the training of their personnel.

Planning and Control of Production

In this function one notes a clear differentiation among the small, medium, and large firms, a great deal of which can be accounted for by the characteristics of the machines produced in each of these categories. In the small firms sector of the sample (11 firms), with a single exception, there is neither differentiation nor formalization in the function; that is, the planning and control of production are carried out by the firm's owner, based on his experience and information gathered in the plant with variable schedules. In many cases, the control function is linked to the direct participation of the entrepreneur in the productive tasks.

In the medium and large firms, in which the value of each machine produced is considerably higher, out of 10 firms, 3 have offices set up with personnel specialized in the subject; in 3 cases specialized engineers manage the function, in 2 cases no differentiation was detected, and it was impossible to obtain reliable information in the 2 remaining cases.

Costs

Even though similar differences between large and small firms can be noted in the management of the cost function - although in the small ones an outside accountant is in charge of handling costs, along with other functions such as finances, taxes, etc., - in no case (with 2 exceptions) was there an indication that the
firms might know their marginal cost and could incorporate that variable in their production plans. This element has a chief importance, particularly in what concerns the design of a long-term strategy for the external sector, which may imply temporary drops in the profit levels in order to retain the markets, and even in what concerns the very strategy of the firm's internal competition.

Conclusions

The evidence gathered in the survey indicates that - with the sole exception of the 3 leading firms - the sector shows an extremely weak capacity of management of the internal organizational aspects and of its relation with the environment, which leads to passivity and lack of foresight in what concerns their evolutions.

The lack of adequate systems of information reception and processing prevents a long-term perspective and limits the search of innovating options* which may overcome the permanent dependence of the sector on the structure and fluctuations of the internal demand.

From the interviews with the entrepreneurs of the sector, it was evident that the "memory" they have with respect to the critical situations in the past even determined the closedown of a high percentage of firms. Nevertheless, the firms do not seem to have accumulated during these 15 years of recurrent crises the experience necessary to lessen their effects, which is shown by the present characteristics of their internal organization.

These problems are not peculiar to the machine tools sector

firms, but rather are common to all small and medium firms to which the industrialization process followed has relegated to a marginal role, and they also affect the firms for which policies or instruments aimed at improving their organizational characteristics have not been designed. As it is analyzed in the section on instruments, all the State promotion policies focus on the credit and tariff aspects, taking for granted a capacity for assessing alternatives on the recipient's part, which - according to the evidence gathered - they do not have.

If one takes into account the fact that the sector finds its expansion possibilities limited by its dependence on quasi-oligopsonic demanding sectors, and the reduced size of the domestic market, the search for alternatives which may allow it to maximize its surplus - which is currently absorbed to a large extent by the buyers -, and the enlargement of the market through exports, become necessary conditions for its future development. To the extent that that may imply the utilization of sophisticated technologies and/or aggressive commercial policies, an adequate organizational structure becomes a precondition.

The problem, in more general terms, is that of defining the role that the small and medium firms should play in the development process, and on the other hand, the proposal of policy instruments tending to overcome situations such as the ones described above.

In mentioning the problem of instruments, one is referring to two aspects: the design of tariff, credit and fiscal policy instruments which take into account the particular rationality and structure of the small and medium firms, and mechanisms capable of inducing a change in the management structures of these firms.
As far as the first aspect is concerned, it is evident that the instruments of economic and technological policy are designed to be applied to firms which are "rational", maximizing, and capable of adequately evaluating the advantages derived from their utilization in their investment decisions. Since this is not the case in most of the small and medium units, it is evident that there exists a lack of articulation between the rationality implicit in the instruments and the characteristics of the recipient firms, which is in many cases a result of inadequate sectorial studies or resistances on the part of the agencies that administrate those instruments to change their "ancestral" application schemes, as in the case of the National Development Bank special credits, analyzed elsewhere.

As for the second aspect, two strategies can be proposed: a) mechanisms of induction and/or coercion on which would force the firms to allot part of their surplus—specially during periods of expansion—to the strengthening of their internal structure; b) associative forms of cooperation between small and medium firms, as it is exemplified by the San Francisco Industrial Park, which would allow the shared utilization of organizational consultants and the access to sources of information related to organizational and management aspects. The second strategy in particular would require the active participation of entrepreneur's associations at the national and regional level.

5. Instruments

In this part of the analysis, an attempt is made to determine the influence that a set of instruments—some of which are also cited throughout this report—might have had on the technological decisions of the entrepreneurs of the sample.
The instruments (and aspects of the same) on which questions were made were:

1. Law of Industrial Promotion (Law No. 20.560), whose explicit goal is to achieve the industrial decentralization, forbidding new settlements or enlargements in the area of the Buenos Aires industrial section. The respondents were asked whether they had attempted to profit from the law's benefits, and in the case of negative answers, the reasons for not doing so.

2. Purchasing power of the State: experience of the entrepreneurs in their relation with the buying State. Technical communication with it.


4. Relationships with the National Institute of Industrial Technology (INTI). Opinion of the entrepreneurs. Concrete cases.

5. Corporation of Small and Medium Firms (COPYME). The entrepreneurs were asked about the knowledge they might have about its existence, and if so, their experience.

6. Long-term credits for re-equipping. The entrepreneurs were asked about whether they used them frequently, what were the ends, and in which banks they applied for them.

7. Special lines of credit for the technological development. It was inquired whether the respondents knew about their existence, whether they had used them, and what the outcomes were.

8. Regime of protection against imports. The entrepreneurs were
asked whether they felt adequately protected against external competition.

9. National Council of Technical Education (agency in charge of training specialized labor of medium level qualifications): The entrepreneurs were asked about their experience with the organisation through the operators trained by it that they could have hired in their plants.

10. Tax reduction system for research: Entrepreneurs were asked about the utilization they might have made of it in their research and development programs.

Some answers:

1. Law of Industrial Promotion: only one of the 23 firms interviewed had decided to profit from the benefits of the law, settling down in the nearby Entre Rios Province. It is a firm whose main activity is foundry and also manufacturers hammers for forging, with a very reduced workers group. The rest of the firms, even though due to the law regulations have their expansion possibilities restrained, consider it impossible to use the incentives to move their settlements, because of the difficulties involved in moving along with the plant the central element of it, i.e. the skilled labor. This problem was unanimously alluded to as the main draw back to this type of law to promote decentralization.

2. Relationship with the State: Reliable information was obtained on 17 cases; out of these cases, 11 firms have frequent relationships with the buying State, and the 6 remaining ones do not sell to or "do not want to sell", owing to a problem
which is common to all of them, even to those which maintain frequent commercial relationships with it: the State's feature of being slow in paying its debts.

From the 11 firms that frequently sell their products to centralized or decentralized firms and agencies of the State, only 4 said they had some degree of communication about the technical characteristics of the machines in question. Among them, 3 firms must be included which are owned by the most important distributor of machine tools in the country, which has a very well set up and specially aggressive department of bidding for public contracts. In the remaining firms, the entrepreneur's statements were of the following kind: "The State never knows what it wants"; "The State prefers to import, rather than developing local technology", etc.

We believe that the most relevant aspect of the relationship between the State and the machine tools firms is that no case was detected in which a significant technological development - or even minor modifications - would have been induced by the former despite the importance of the volume of its purchases. Further, in all cases the bad experience in the commercial aspects - due to the delays and defaults on its payments - limit the influence that the State might have on the sector's firms.

3. Incentives to exports: All the firms that were exporting at the time of the survey, or those which had had a continuous exporting experience in the past, manifested they were satisfied with the characteristics of the exports promotion system, which functions in an automatic fashion (reimbursements, drawback, etc.). The system in question is direct, without any selectivity, which rewards just the fact of exporting.
4. Relationships with the National Institute of Industrial Technology (INTI): The entrepreneurs were specifically asked whether they had ever resorted to the INTI in order to solve technological problems or other type of requirements (metrology, quality control, etc.), and about the outcomes of such relationships.

From the 21 firms on which reliable information on the subject was obtained, 8 had had some relationship with the INTI, in all cases for tests or metrology. Only one of the firms in this situation stated it had come out satisfied with the job performed by the INTI (a control of precision instruments). In the remaining cases, the entrepreneur's opinion with respect to this institution was very unfavorable, for reasons such as: "Too bureaucratic", "Too expensive", "Too slow", etc., which results in all cases in the decision not to resort again to INTI, not even for simple inquiries.

It is also worth citing the case of a firm, one of the leaders of the sector, that stated it did not use the INTI's services since its own equipment and human capacity surpass those of this institution.

Among the firms that have never resorted to INTI were found three settled in San Francisco City - Cordoba - which for reasons of proximity, sent their requests of technological services to centers in Cordoba and Santa Fe.

In summary, the general impression is that the role that - inadequately - the INTI seems to play with respect to the sector, is that of supplier of technical services, without any influence on major technological requirements, such as information, proposal of trends for the evolution of the sec-
5. Corporation of Small and Medium Firms (COPYME): With reference to this recently created institution, whose goal is to support the development of the small and medium firm on several fronts: commercial, financial, technological, of raw materials supply, etc., an attempt was made to find out whether the entrepreneurs interviewed had some type of relationship with it, particularly in what concerns technological problems. The result was disappointing: only three out of the 23 firms interviewed knew about the existence of COPYME, but in no case had they had a relationship with the same. The 3 firms being referred to - which knew about the existence of COPYME - are located in the San Francisco area, and knew the institution through the information services of the local Association of Metallurgic Industrialists.

6. Long-Term Credit: From the 18 firms on which reliable information was obtained, 8 had never resorted to long-term credit for re-equipping. From the other 10, 7 had obtained credits from the National Development Bank and the remaining 3 from the Buenos Aires Province Bank.

In all cases, the entrepreneurs made reference to the "long red-tape" necessary to obtain the credits applied for which, in the team's opinion, can be attributed to the nonfulfillment on the part of those firms of the minimum tax, social security, etc., requirements requested by the Bank system in order to grant credits.

7. Special Credits: This question referred to the following lines of special credits, granted by the National Development Bank: credits to foster exports; credits for pre-investment
studies; special credits for the development of the small industry; for the installation of pilot plants; for the development of prototypes of capital goods; for support to Argentine industrial professionals.

The results were the following: from the 22 firms on which reliable information was obtained, in 10 cases there was no knowledge of the existence of those lines of credit; from the 12 remaining cases which know about these credits, 4 attempted to attain the lines, but "the excessive red-tape", "the bureaucratic obstacles in the processing inside the Bank", etc., were responsible for the failure, according to the respondents.

In summary, none of the firms of the sample, which represents around the 75% of the production value of the machine tools sector in Argentina (all of them small and medium), utilized these lines of credit, which at least in their explicit objectives, are aimed at supporting their development.

8. Customs Regime: All the entrepreneurs interviewed stated they felt adequately protected by the customs system in force, although in some cases they made reference to the problems created by certain imports coming from socialist countries, and to the inflexibility of the system in the cycle. Several respondents stated, specifically, that they did not feel the foreign competition on their own products.

9. National Council of Technical Education (CONET): from the 20 firms on which reliable information could be obtained, only one stated a positive opinion about the training activities developed by CONET. All the rest, influenced perhaps by the situation of scarce skilled labor detectable at the time of the survey, made all kinds of criticisms to the action devel-
oped by the CONET, whose poor results, in their opinion, are reflected in the characteristics of the qualified personnel the CONET sends to the market, which does not meet the requirements of the sector's firms. In general, there springs from the interviews the absolute disconnection existing between the Council and the entrepreneurs, either in individual form or through the Entrepreneur's Chambers.

10. Tax Reduction System for Research: The firms were asked whether they had made use of this incentive to the research and development activities which they might have undertaken. In no case did the entrepreneurs use that incentive, even in cases of new machines which could have been contemplated by the prescriptions of the institute being referred to.

Conclusions

As it was stated at the beginning, questions were included in the survey aimed at detecting the influence that various policy instruments could have had on the technological decisions of the entrepreneurs. Questions were included referring both to instruments directly linked to the supply or demand for technology (INTI, special credits, tax reductions, etc.), and to others of general industrial policy (exports and imports regimes, long-term credits, law of industrial promotion, etc.). The lack of utilization by the firms of the instruments directly related with their technological decisions, and the non-selectivity of the instruments of general industrial policy, allow for the conclusion that none of them have any influence on the technological decisions at the firms' level.

The entrepreneurs stated they were satisfied only with the regimes of promotion to the exports and of control of the imports.
Our hypotheses on the reasons for such agreement are that they are not selective (automatic nature) in the application of them. The regime of promotion to the exports has a general and automatic application, is part of the price of exports, and does not require any special characteristic on the part of the firm benefiting from it; it is sufficient that the latter exports.

The customs regime of protection against imports is the instrument on which the greatest efforts of the sector's industrialists have been directed through their Chamber. The latter defends the maintenance of the level of protection and evidently - according to the entrepreneur's opinions - has done it efficiently.

Yet when the points in question are either instruments which demand meeting certain minimum conditions by the firms (financial, technological, etc.), such as in the case of special credits; or instruments which require a positive action on the part of institutions to influence the technological behaviour of the entrepreneurs (INTI), State firms or agencies, COPYME), there is a total disconnection. The design of the instruments in the former case, and the inefficiency and lack of plans of the institutions in the latter, seem to be the determinants of the situation.

The law of industrial promotion is a clear case of poor design of an instrument, which is not applicable - owing to its characteristics - to a large set of industries whose fundamental element of development is the skilled labor, which does not exist in the areas the law seemingly wishes to promote.

Another case of instruments designed for firms whose characteristics differ from the small and medium ones which have been
surveyed, is that of the special credits for technological development, which requires of the candidates the knowledge of technological information, and financial capacity, as a prerequisite to acquiring the credits. All of this explains their lack of use on the part of the small and medium firms of the machine tools sector.

6. General Conclusion

From the evidence gathered throughout the present work, the more general conclusion is that the sector as whole has little possibilities of accompanying a process of sustained growth of the technological requirements of the demand, and of enlarging its participation in the external market, unless some characteristics of the environment, of the firms' themselves, and of the products manufactured are modified.

The firms of the sector are passive recipients of the technological requirements imposed by the demand, which for the levels of greater sophistication, correspond to the large foreign firms, particularly those of the automotive sector. Hence, a policy for the machine tools sector cannot neglect the action on the demanding agents.

This action on the demanding firms should be one of the forms in which the modification in the action patterns of the State is expressed, which must begin with its top priority participation in the global accumulation and a reform in its capacity for planning and expressing its technological demands, channeling the same primarily towards the national capital.

In the same sense, the effectiveness of the proposals stated below depend on the role that the global policy would assign to
the small and medium national firm.

With respect to the modifications at the firms' level, the problem has been extensively analyzed in the chapter on management, and will be dealt with again in analyzing the average size of the same.

The whole technological policy must arrive at the modification of the characteristics of the locally manufactured products. With respect to this subject, the proposals must make a distinction between the type of locally manufactured products, and the construction characteristics of them.

With the exception of the large size machines or those made totally automatic, the Argentina production covers a very broad spectrum of needs, particularly at the simpler levels. The advanced construction characteristics, on the other hand, are concentrated in a very small number of firms that manufacture special or semi-automatic machines, particularly by cutting machines.

The "simpler" machines are specially appropriate for present needs of the Latin American and African market, as demonstrated by the average value of the machine exported to those markets. Likewise, they are machines whose demand will enlarge to the extent that new developments take place in the sectors producing capital and durable consumption goods in those countries. The experience accumulated and the capacity set up in Argentina, in relation to potential competitors in the area, assure our country excellent possibilities to become one of the main suppliers of this type of machine, provided that: a) a gradual process of incorporation of construction improvements takes place, particularly those referred to as kinematic features and systems of measurement and control, in accordance with international norms; b) competitive
and stable prices are obtained in the long term; c) systems of "service" are established, similar to those offered by the more sought after foreign suppliers, for which our country, in Latin America, has the advantage of physical proximity.

These proposals, to attain a greater penetration of the simpler and lighter machines in the Latin American and African market, will not be achieved if the evolution trend that the sector has shown up to the present is continued. The latter needs and external "push", of the type proposed are in the following pages.

As for the machines having greater weight and value - those at 3,500 dollars/ton - they are the ones that have shown the greatest incorporation of technological advancements, although they are concentrated in a reduced number of firms. For lathes, milling machines and some transfer and special machines, the field is favorable to get into numerical control, as the next step in the technological evolution of the firms. The advisability of taking this step lies not only in the need to gain ground in a market supplied by imports, but, above all, in the experience derived from the set of problems that must be resolved in order to reach the peak in the application of numerical control to a machine tool. This is a typical case in which the "dragging effect" may modify the technological characteristics of the whole industry.

From the study of the possibilities afforded by the technological evolution at the world level, undertaken below, it becomes evident that the "secret" is the opening of the technological package constituted by the design, the constructive characteristics and the parts and accessories, in such a way that a process of gradual substitution of national elements for foreign ones could be carried out, while at the same time the local learning is strengthened. Argentina, due to its tradition in the industry and
to the capacity of its scientific system, has an initial advantage with respect to the other countries of the area attempting developments in this field.

An adequate standardization policy must contribute to all of the above, since through it the State should set the technical patterns to which the evolution of the sector must conform.

One final observation with respect to Entrepreneur's Chambers: from reading their records and interviewing some of their leaders, there arises the secondary role attributed to the technological factor in their union activities. Problems such as customs protection, credits, tax system, etc., are the ones which take most of their time: and this is understood when one considers the chronic instability of our country during recent years. This is the reason why a policy of technological development should probably be carried out without a resolute support of the Entrepreneurial Chambers, specially when the former must imply certain coercion. These resistances should lessen to the extent that there exists some degree of participation which permits the entrepreneurs to begin to see the long-term benefits implicit in such policy.

Policy Proposals

The evidence set forth about the structural characteristics of the sector and its relationship with the general dynamics of the economy, show the set of retarding elements for any proposal of technological development.

Those which arise most clearly in this regard, are the size and the instability of the market; the average size of the firms; the system of external protection; the lack of external technolog-
tical support for the firms.

The solution to these problems may involve a global modification of the framework in which the activity of the sectors producing capital goods in the country is developed. Yet for the concrete case of machine tools, specific lines of action can be proposed, which emerge from the material gathered through the surveys and the experience of other countries. To the end of a better exposition, those lines of action will be divided on the basis of the problems stated above.

Size and Instability of the Market

It is not necessary to go too deeply into the adverse effects which for any program of investments, specially if they imply significant technological change, are induced by uncertainty about the future evolution of the demand. In the case of the machine tools industry, this factor is worsened by the reduced average size of the firms, specially if it is related with the amounts needed for the renewal of fixed capital.

Likewise, in markets where the technical obsolescence is slow, it can be shown that a great cyclic expansion of the sales during a period conditions the size of the future demand, which accelerates the retractions caused by the investment cycles*.

A fundamental element of any policy proposal for the sector must therefore be to attain the attenuation of the rough cyclic evolutions which affect the sector.

* To put it differently, the demand for machine tools is not a flow, but rather it is "stock", which can be saturated.
The total current demand for national machine tools—just above 25 million dollars—has a dimension which, at least in the international comparison, turns out to be insufficient for aiming at significant projects of technological development. This reduced global size is still much lower at the level of specific products, in an excessively fragmented structure, specially for the products of more complex technology.

Both situations, instability and size of the market, explain the limited growth of the productive capacity observable in the sector. Not only has the supply grown much less than the demand in recent years, but also during periods of a great euphoria of demand, such as the one corresponding to the time of the survey, most firms work only one shift, even though the orders may exceed the 6 months of production.

In this context, the expansion via the external market turns out to be the main means to guarantee a secure and long-term increase of the national productive capacity. As is cited in the pertaining section, Argentina has lost relative participation in the expansion of the import of machine tools to the Latin American market, particularly if Mexico and Brazil are considered, despite the increase of the total exports of the country. It can be foreseen that, unless the elements determining the exporting activity are modified, Argentina will lose similar opportunities in other countries whose demand for machine tools begins to show a great expansion, such as the case of Venezuela and Ecuador.

The Argentine possibilities of exporting to Latin America are at the level of products having an average value around 2,000 and 3,500 dollars per ton, which is, on the other hand, the average size of the Argentine production. This average value is reduced by between 30 percent and 50 percent if the markets in question
have a lower development in their technological requirements, as in the case of some African countries. In any case, the concrete specification at this level is beyond the possibilities of the present work.

Starting from the information gathered in the contacts with the sector, the team believes that at least the following elements must be included in an exporting policy: a) information; there is no updated and sufficiently disaggregated information (at the market and product level), which may guide the productive sector - and the authorities - about the priorities to be granted; b) stability of the incentives; the continuous fluctuations in the relative and absolute prices of an economy undergoing inflation limit the effectiveness of the conjunctural incentives to the exports, and form one of the determinants of the fluctuation of our products in the external market; c) management structure of the firms; even though this is a subject which is referred to in detail below, it is clear from the survey that the present management capacity at the firm's level does not allow the maintenance of a continual exporting situation. Hence, the expansion towards the external market will ultimately be the result of the modification of the structure at the firm's level; d) technological characteristics of the products; this subject will be dealt with below, along that referring to the technological structure.

In the second place, one should include the action of the demanding State. It has not been possible to quantify the effect of the public sector firms on the total demand for machine tools. A first approximation would be given by the fact that the public investment in economic sectors represented, in 1974, 27 percent of the total investment, a figure that for the purpose of the present specific interest is multiplied is one considers the type of productive activities and services handled by the State in
Argentina. This enormous purchasing power has not been utilized as an element of anti-cyclic policy. On the contrary, and due to restrictions in the income structure of the State and the lack of a coherent policy, the State accompanies (and consequently worsens) the cyclic crises. A reversal of this behaviour pattern could be attained through two means: a) the effective centralization of the investment decisions of the State, through the action of the Corporation of National Firms; b) the multi-annual programming of the State purchases, implemented by means of firm contracts which would guarantee the demand to the suppliers.

The natural precondition to the latter, at the level of the concrete demand for machine tools, is the capacity for decision and planning in terms of technological alternatives at the level of the State firms, which, according to the evidence gathered, does not exist at present.

Finally, one should point out a factor whose reversal will be the result of the integral modifications of the technological evolution patterns of the sector. As the evidence presented in analyzing the history of the machine tools imports suggests, the greatest technological requirements of the local demand have been met by the foreign supply, which accounts for its stable participation in the apparent consumption. The sensible differences in the levels of productivity and precision offered by the foreign machines with respect to the average of the national production lead to foresee a widening of the gap, and a consequent decrease in the market size for the national production. This is why not only a modification in the technological characteristics of the national supply, but also the national entrepreneurs' possibility of planning and inducing the technical obsolescence of the local park of machines, are means of enlarging the market. However, as is stated above, this will be the result of a change which includes
the technological evolution patterns and the management capacity of the sector.

Size of the Firms

According to the evidence gathered in the present research, the sector in Argentina is composed by the following sets of firms:

- Firms with capacity for sustained innovation, possibilities of international competition and survival from the recurrent crises of the domestic market. The firms of this capacity are no more than 6 or 7, and their size, which is large in relation to the local average, turns out to be small in comparison with the large firms of the exporting countries. They are, however, firms that, given the financial and human capacity they have available, may expand themselves as the market which they supply does the same.

- Firms of medium size (between 20 and 50 people), followers of the latter in the areas of the local market which they attend to. They have been the most severely affected by the internal crises, since their size imposes them certain rigidities in terms of capital and labor force which they cannot overcome due to their limited financial capacity. The technological evolution of this set is characterized - as it was seen in the pertaining section - more by the differentiation of models than by the addition to the machines of elements which might effectively modify their durability and precision characteristics.

- Set of small firms and workshops, scarcely specialized, in which the manufacturing of machine tools turns out frequently to be marginal. This group of firms satisfies an artisan-like
market, with limited technological requirements, not only in the country but also in the rest of Latin America.

The size of the firms constitutes, in all cases, a restriction, both to undertake technological development projects or conquer of new external markets, and to overcome the recurrent cyclic crises of the local market.

The solutions that may be proposed are of two types: a) merger of firms; b) structuring of cooperative systems which would allow the joint utilization of technical, financial and management services.

The proposal of merger is only viable for firms of the second group. The heterogeneity of the products manufactured by the first, as well as the diversity of origins and interests of the capitals which control them, limit the possibilities of this action among the large firms.

At the level of the small firms, the low degree of specialization, and their entrepreneurial structure of an artisan nature, would also limit the effectiveness of a policy tending to promote mergers.

The utilization of common services, which has proven its efficiency in the case of the San Francisco Industrial Park, requires the direct participation of the Entrepreneurs' Chambers. Through the joint action of the Chambers and agencies of technological, financial, etc., support of the State, it is possible to integrate structures which provide support for the firms in areas which the latter cannot cover individually, particularly, technical information, quality control, consulting services, training of skilled personnel, commercial information, search and handling
of new markets, etc. The precondition for an action along these lines is a change in the priorities of the entrepreneurs' groups, which at present relegate the technological and management aspects to a marginal position. The government has at its disposal the possibility of establishing differential benefits or programs of promotion for this type of activity undertaken in an associative fashion, which opens up enormous possibilities for the firms of lesser resources.

**Tariff System of External Protection**

The main characteristics of this system are its instability and its non-selectivity. The system is unstable as a factor of protection, in the face of the permanent evolutions in the external value of the peso which characterize the Argentine economy. An approximate estimate which is shown in the relevant section, indicates the variations in the level of protection in the latter years, although in no case did the sector remain unprotected.

The main feature, however, from the standpoint of a technological policy, is the non-selectivity of the system, which applies a uniform tariff to all the products of the sector, without even proposing mechanisms of gradual decrease (or increase) of the protection levels on the basis of variables such as the utilization of national or foreign technology, the ratio internal cost/external price, etc. In other words, the tariff system is not useful - under its present form - as an instrument of technological policy or of promotion of the international competitiveness of the machine tools.

A modification of the tariff system aiming at technological policy requires as a precondition an adequate capacity for evaluation, on the part of the authorities of industrial policy, of the
present and "desirable" characteristics of the evolution of a sector. Otherwise, the selectivity and the gradualism are not possible and the system advances by steps, starting exclusively from the entrepreneurs' demands, rather than by policy decisions of the State.

The foregoing is also applicable to the schemes of promotion of exports in force, characterized by their rigidity and non-selectivity.

**External Technological Support**

This is one of the most remarkable lacks detected throughout the present work.

A policy proposal in this field must begin by considering the technological support as a complex set of activities tending to promote the demand for technology, meet the technological requirements and foster the development of the technological capacity of the firms.

Conceived of in these terms, the technological support starts by the differential treatment of certain products as a function of their technological characteristics. The most fitting instrument in this connection is a "quality seal" granted by an agency of technological policy which, in addition to forcing competition between producers for its attainment, should operate as a guarantee for the possible local and foreign demand agents.

The seal of quality should be granted as a function of certain pre-established standards which would include not only conformity to norms but also sensible advancements in relation to the local average.
As a function of the experience gathered during the present work, it can also be asserted that such a quality seal, adequately handled, would enlarge the local and international market, fostering the adoption of the innovations generated by the local supply.

The most adequate agency to grant this seal is the Center of the Machine Tool, to be created within the domain of the INTI.

In conjunction with this innovation-fostering mechanism, a structure of extension is required, capable both of interpreting the technological needs of the more "artisan-like" units, and of maintaining an adequate communication with the engineers of the higher level factories.

The extension service proposed must be linked to the institutes of the scientific system which perform tasks related to the problems inhering in the machine tool. Even though for certain type of firms it is necessary to start from the rudiments of quality control, for some of the leading firms the direct contact with research institutes is necessary to continue with their technological evolution process.

Finally, the scheme of technological support must include instruments which foster the incorporation of technical personnel to the plants, for instance, through tax reductions and lines of credit which would allow the purchase of sets of scientific instruments.

Possibilities for a Technological Policy

a. International Market

If one assumes as desirable, in terms of the general strategy
for the sector, a technological policy which tends to increase the levels of productivity of the locally manufactured machine tools, through the incorporation to the same of the latest advancements at the world level, one must first of all give some thought to the feasibility of such proposal.

We understand that the viability of such proposal lies in the opening of the machine tools "technological package", emphasizing the possibility of obtaining certain components of that package in the international market, until their local development is achieved.

The forerunning technological evolution during late years has been the result of three elements that, although they are found in the machine tools unit, can be differentiated from the standpoint of the origins of their development and of the possibilities of obtaining them in the market:

- design
- constructive characteristics
- parts and accessories

These elements have developed at different speeds during latter years, producing a mutual enrichment which has led to the general advancement of the sector. Thus, one may speak of three "markets" in which it is possible to obtain independently such elements; this permits a great flexibility for the implementation of a technological policy, provided there exists a minimum engineering capacity for the selection and evaluation of alternatives and for the integration of the elements.

The parts and accessories market, which has played a fundamental role in the advancement of the machine tools in central
countries, is highly dynamic and diversified, and above all, independent from the machine-tool market in the strict sense. In other words, it is possible to acquire separately units of measurement and/or control of varied degrees of sophistication; cutting tools; lubrication or cooling systems, from various supplying countries which compete among themselves.

The constructive characteristics and the "general conception of the product" can be obtained through the copy, provided there exists the necessary engineering capacity.

The critical element in this scheme is the design, which Vidossich rightly calls "composition know-how", which allows the harmonious conjunction of these varied elements in the final performance of the machine tools. The capacity for design can be obtained through the training abroad of human resources with a good engineering background, and the capacities thus acquired can be permanently updated through the sources of information coming from countries with greater advancement in this field.

In contrast with what happens in the process technologies, it seems possible in the case of the machine tools to obtain a substantial part of the embodied-disembodied technology, without it being necessary to get bound to contractual relationships with the foreign possessors of the same, and exploiting the external technological input while the local capacity of absorption and generation is developed.

The foregoing concepts could be synthesized in the idea of the flexibility with which a technological policy for the machine tools sector in Argentina might be approached, in what refers to the origin and mode of obtaining the knowledge necessary, through the combination of the possibilities of copy, purchase of parts
and its own development, provided there exists a minimum local
capacity of evaluation and selection of alternatives, which is
necessary to develop as a precondition.

b. Local Capacity

While it is true that one of the main conclusions of the present
work is the limited present generation of useful scientific
knowledge for the machine tools sector, such evidence must be anal-
yzed with another approach when thinking in terms of long periods.
In effect, this is not the case of a situation of structural in-
capacity of the scientific system and its human resources, irre-
versible in a relevant period, but rather it is the result of the
lack of a demand expressed by the productive sectors, as well as
the marginal role attributed to the problem by the planning State.

In the survey of institutions capable of generating knowledge
linked to machine tools - on which reference is made in the sec-
tion "technological support of the sector" (p.26), in studying
those programs in execution, a total of seven institutions have
been detected (6 university ones and the National Institute of
Industrial Technology), which have applied for funds to the CONACYT
in order to reinforce or initiate a total of 16 research projects
related to the subject. Those projects imply the following utiliza-
tion of human resources, measured in No. of researchers/average
weekly hours of dedication:

<table>
<thead>
<tr>
<th>Independent Researcher</th>
<th>Associate Researcher</th>
<th>Principal Researcher</th>
<th>Research Assistance Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>29/23</td>
<td>29/20</td>
<td>34/28</td>
<td>37/32</td>
</tr>
</tbody>
</table>

One should add to them other research institutions that depend
on various financial sources, such as the case of the National Commission of Geo-Heliophysic Studies, which is referred to in this report.

It would thus seem that in the Argentina case it would not be necessary to start totally from zero in order to have a certain capacity for technological creation, but rather it would be necessary to strengthen the same through human and technological resources which it already possesses.

This optimistic perspective for the long term in reinforced if such possibilities are considered in relation to other countries of the Continent which might be either consumers of Argentine products, or potential competitors in the regional market, and in those for which there is not a similar basis for the creation of technologies in the sector. This is, therefore, a central element to be taken into account in order to attempt a sectorial policy which would be based among other elements, on the expansion towards the external market.
APPENDIX 1

The technological advancements at the world level

The parameters that define the technological advancement in the machine tools in the most advanced centers in this field are: automation, speed, precision, size and versatility.

Automation: The advancements during recent years in the field of numerical control systems for machine tools can be summarized in the following points:

- Applicability of the numerical control techniques to the whole spectrum of cutting machine tools.

- Possibility of simultaneous or successive control of several machines, including diverse programs, with just slight changes in the software.

- Self-correction and self-diagnosis systems, detection of problems and optimizing of the cutting conditions of the tools: adaptive control.

- Growing standardization of the programs to lessen the participation of the programmer in each operation.

- "Self-programming" systems by computers which, starting from the basic data of the piece to work on and the technology chosen, automatically perform the programs to be subsequently placed in the numerical control systems.

At present, control systems are easily available in the inter-
national market, without being necessary to acquire the whole machine tool set. Such systems are adaptable to diverse types of machine tools, with the sole utilization of adequate adapting circuits, that is, blocks laid between the machine border (or its network of logic command), and the command system. The only limitation with respect to the command systems is given by the specific requirements of the functional characteristics of the machine.

Speed: The developments in the constructive characteristics of the machines, which allow almost total reduction of problems of vibration in the structures, and the even more important advancements in the field of the cutting tools, have led to cutting speeds which can be rated as amazing. In this respect, it is interesting to point out that the machine tool manufacturers themselves of the industrially most advanced countries admit that the developments in the tools are the factors which have induced the improvements in the productive possibilities of the machine tools, in showing the existence of a working capacity which is not exploited.

The improvements obtained allow not only work at cutting speeds up to 2,500 feet per minute, with metal extractions reaching up to 14.4 cubic inches per minute, but also the performance in resistance to pressure and temperature has been improved in the same proportion, thereby eliminating one of the main bottlenecks in the rapid work on metals.

Precision: The utilization of electronic instruments of measurement, coupled directly to the command systems of the machines, allows achievement of absolute precision, with minimum tolerances, even in very large pieces and with a virtually nil deviation.
The latter is linked to the developments observable in the quality control techniques, which have been made in such a way that they become totally integrated to the productive process as a unit, thus placing more emphasis on the integral performance than in the final control. This change of approach to the problem has had direct effects on the machine characteristics, considered individually as units within the productive process.

Size and versatility: The development of the machining centers, and the application of the numerical control techniques, have allowed execution of highly complex sets of operations. There are virtually no limits to the size of the pieces to be produced. In the machines that work by deformation, the developments in the machine feeding systems, as well as in the automation, allow work with pieces of all sizes, with total safety and precision. The developments in the lubrication systems of the large units act along the same lines.

All of the above-mentioned developments require constructive characteristics in the machines which are proportional to the performance demanded; this is the reason why they have been accompanied by a permanent incorporation of improvements in this regard, particularly in the utilization of increasingly light and resistant metals, as well as in the increasing incorporation of high resistance plastic elements.

**Numerical Control**

The numerical control machine tools are the result of the joining of the machine tools mechanization and the automatic treatment of the information through the interface of the driving and regulating systems. Thus, the machine functions in an automatic
or semi-automatic manner, starting from the instructions given
them in a coded way by the command system on the basis of a pre-
viously made program.

In this manner, the numerical control machine introduces an
entirely new dimension: the machining process is given to the ma-
chine tool in the way of numerical data expressed by punchings in
the tape or disk, which works as an instruction carrier. The sum-
mary of these data constitutes the machine program, that is, a
closed cycle that performs all of the activities necessary to ob-
tain the prescribed dimensional accuracy and external of the piece
being machined.

The machine thus handles both its operation elements, to ad-
just its cutting conditions, pre-established revolutions and ad-
vances, change of tools, and the auxiliary functions such as ad-
mission of the refrigerant, fastening of the tools, stopping of
the machine, etc. Thus, the outcomes in the technical operation
of the machine depend directly on the quality of the program.

Structure of the productive process: Perhaps the most important
element to be taken into account in assessing the advisability of
introducing a numerically controlled machine tool in a conventional
process, is the change in fact implied by the new machine in the
productive sequence and even in the firms' management. In a study
which has been used as a source, reference is made to a "new phi-
losophy of production". Such philosophy of production starts from
the need of assuring a constant feeding to the machine, and of
adapting the subsequent sequences of the process as a function of
the greater operating speed of the numerically controlled machine
tool. In this regard, it should also be pointed out that the eco-
nomically optimum ranks at the level of number of pieces should be
complemented with a utilization of the machine during at least 2
complete shifts. Surveys undertaken to this effect show the favorable economic possibilities of working 24 hours during more than 5 days a week.

On the basis of the foregoing considerations, the functions of entrepreneurial management gain importance, particularly those of costs and production, purchases and sales planning. If the administrative structure in those areas is not organized so as to permit to assure a continuous full functioning of the productive structure - particularly that of the numerical control equipments - nor to make it possible to assess in economic and financial terms their outcomes, the utilization of numerical control can be counterproductive.

In what concerns the "technical environment" of the numerically controlled machine, a scheme is required that would: a) reduce the active times by a better exploitation of the machine tool-piece system; b) drastically decrease the passive times, by means of a re-statement of the problem of change and positioning of the pieces.

The latter implies an adequate organization of the sectors of preparation (methods) and execution (workshop).

The conception of the product and its machining technology cannot be based on artisan or "trial and error" schemes; rather, they imply the existence of personnel trained in "machinery theory", capable of foreseeing the problems that can be caused by the work on the pieces and of solving them in advance in the system programs.
San Francisco Industrial Park

We believe it is of interest to make a brief reference to the San Francisco Industrial Park, which is considered a very useful experience, relevant to the present work.

Above all, it should be pointed out that in San Francisco - a city with a long industrial tradition despite its reduced size - an important set of metallurgic firms is concentrated, particularly of the machine tools sector.

There are in San Francisco 27 establishments (20.3%) of the sector, which produce 20% of the total production of the country and export 30% of the national exports of machine tools.

Over 6 years ago, the idea was developed of setting up an Industrial Park in the outskirts of the city, with a twofold objective:

a. To allow a relief in the physical work conditions in the establishments.

b. To set up and exploit a wide range of services common to all of the Park's members.

A Civil Association was created with the goal of carrying out the idea, and it obtained the support of the United Nations Development Program through a Technical Cooperation Project. This support consisted basically in the sending of experts (in industrial engineering, foundries, electrical engineering, organiza-
tion), and equipment to set up the systems of common technologi-
cal support.

From that moment on, and despite the fact that the project of moving to the Park proper has not been fulfilled due to the lack of State support, the experience has been very rich and full of greater possibilities.

The premises of technological action of the Park were:

a. To improve substantially the technological and organizational conditions of the firms, as a step preceding their definitive move to the new plants.

b. To achieve the set up and full exploitation of the common centralized services of technological support, specially those of materials testings, design, consulting, etc.

For the first objective, a permanent extension task-force was developed through the experts of the UNDP; they were in turn accompanied by engineers of the same city in a training program. In this manner, the aim was achieved not only of correcting some primary deficiencies of the productive processes, but also of accustoming the entrepreneurs to expressing their problems in concrete technological requirements.

These requirements were directed to the metallography, mechanical tests and chemical analysis equipments which were set up in the Park's headquarters.

The experts in industrial organization concentrated on problems of workshop lay-out and organization.
During this first stage, according to the Park's authorities - who are entrepreneurs of San Francisco - the goal has been reached of creating in manufacturers the "vice" of quality control in the raw materials, the process and the final product.

These common services are to be substantially enlarged in the definitive settlement of the Park, since there is the intention to set up a central purchases office; central storehouses of finished products; common packing systems for export; joint purchase and utilization of machinery of high value and low coefficient of individual utilization. In a second stage, it has been planned to set up plants which would produce critical parts of general use in the firms, such as gears.

Independently of whether the project eventually obtains the State support which would allow its definitive materialization, and taking into account the particular situation of a relatively small community such as San Francisco, the team believes that the idea of the Park contains valuable elements which should be analyzed.

The first refers to the role played by the Association of Metallurgic Industrialists which leaves a passive role to the Entrepreneurial Chamber in order to attempt a direct action on the technological-economic characteristics of their members' production. This is noted not only in the conception of the Park, but also in the system of periodic information on technological, financial and tax subjects that the Association maintains for its members, so as to even out the chances of access to the information.

In relation to the latter, one should point out the unquestionable economic advantages that the organization of the Park implies for its members. Both the technological services and the
common general services are expressed in improvements of certain
costs which would be impossible to achieve individually in the
medium and small firms. At the same time, the chances of having
such advantages are evened for the various types of firms which
-at any rate formerly- had to resort to State laboratories or
institutes, with uncertain results.

Finally, it is felt interesting to show the sequence followed
in the activities of technological support for the sector, which
begins with the most "primary" elements of improvements of the
productive process, continues later on with quality control, and
finally attempts major changes at the design level. Thus, the
entrepreneurs have been gradually introduced into a scheme of tech-
nological advancements which can be absorbed starting from their
limited engineering capacity.
PARQUE INDUSTRIAL PILOTO DE SAN FRANCISCO S.A.

General Summary of Jobs Year: 1974
Month: December

Common Laboratories of the San Francisco Pilot Industrial Park S.A.

<table>
<thead>
<tr>
<th></th>
<th>December</th>
<th>Total</th>
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<tr>
<td>1. Summary</td>
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<tr>
<td>1.1.</td>
<td></td>
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<tr>
<td>Applications for jobs made</td>
<td>23</td>
<td>325</td>
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<td>1.2.</td>
<td></td>
<td></td>
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<tr>
<td>Number of jobs performed</td>
<td>260</td>
<td>1852</td>
</tr>
<tr>
<td>1.3.</td>
<td></td>
<td></td>
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<tr>
<td>Number of applying firms</td>
<td>17</td>
<td>64</td>
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<tr>
<td>2. Jobs Performed</td>
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<tr>
<td>2.1.</td>
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<td></td>
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<tr>
<td>Chemical analysis of elements</td>
<td>60</td>
<td>952</td>
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<td>2.2.</td>
<td></td>
<td></td>
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<tr>
<td>Mechanical tests:</td>
<td></td>
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<tr>
<td>2.2.1.</td>
<td></td>
<td></td>
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<tr>
<td>Universal Machine</td>
<td>10</td>
<td>132</td>
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<tr>
<td>2.2.2.</td>
<td></td>
<td></td>
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<tr>
<td>Durometer</td>
<td>108</td>
<td>284</td>
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<tr>
<td>2.2.3.</td>
<td></td>
<td></td>
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<tr>
<td>Concrete pressure gauge tests</td>
<td>52</td>
<td>52</td>
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<tr>
<td>2.2.4.</td>
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<td></td>
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<tr>
<td>Other tests</td>
<td>-</td>
<td>11</td>
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<tr>
<td>2.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metallography</td>
<td>19</td>
<td>131</td>
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<tr>
<td>2.4.</td>
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<td></td>
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<tr>
<td>Thermic treatments</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>2.5.</td>
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<td></td>
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<tr>
<td>Non-destructive controls</td>
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<td>9</td>
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<tr>
<td>2.6.</td>
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<td></td>
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<tr>
<td>Casting earths</td>
<td>1</td>
<td>109</td>
</tr>
<tr>
<td>2.7.</td>
<td></td>
<td></td>
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<tr>
<td>Fuels</td>
<td>-</td>
<td>27</td>
</tr>
<tr>
<td>2.8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various: Dictums, reports, etc.</td>
<td>7</td>
<td>101</td>
</tr>
<tr>
<td>TOTAL</td>
<td>260</td>
<td>1852</td>
</tr>
</tbody>
</table>
In addition to the routine tests, the following tasks have been performed:

- Research on nodular foundry, including determination of furnace charge, melt control, verification of chemical, physical and structural characteristics, before and after thermic treatments of ferritization and normalizing; obtained varying time of permanence, temperature and cooling speed.

- Determination of factors which cause cracks in rolled steel of high C and its subsequent propagation through inclusions zone.

- The performance was started of compression tests of concrete pressure gauges using Compression Test Press of 110 Tons acquired by the San Francisco Pilot Industrial Park S.A. for that purpose.

SAN FRANCISCO, January 11, 1975
Roberto Ron. Contraparte.
STATISTICAL APPENDIX

TABLE 1

<table>
<thead>
<tr>
<th>Size of the firm</th>
<th>Number of firms</th>
<th>Fixed Capital (in thousands of Dollars)</th>
<th>Number of firms</th>
<th>Personnel employed</th>
<th>Ratio* Capital/labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>11</td>
<td>10573</td>
<td>12</td>
<td>1226</td>
<td>9.4</td>
</tr>
<tr>
<td>Medium</td>
<td>17</td>
<td>2609</td>
<td>20</td>
<td>648</td>
<td>4.8</td>
</tr>
<tr>
<td>Small</td>
<td>32</td>
<td>2531</td>
<td>41</td>
<td>548</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Source: Data obtained from the study "Structure of the Machine Tools Industry"

* Team's own elaboration.
# Table 2

**Production by Type of Machine**

(In units)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>With cuttings tear off</td>
<td>6473</td>
<td>4021</td>
<td>3874</td>
<td>7487</td>
<td>8856</td>
<td>5550</td>
<td>4355</td>
<td>7276</td>
<td>8355</td>
<td>9978</td>
<td>10484</td>
</tr>
<tr>
<td>Boring machines</td>
<td>2449</td>
<td>1707</td>
<td>2030</td>
<td>4560</td>
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<td>367</td>
<td>224</td>
<td>338</td>
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Source: D.N.E.I., on the basis of the sectorial survey and L.N.P.A.I., quoted in "The Machine Tool Industry" POZZO, year 1971 from the study by DGFM.
TABLE 3

PRODUCTION BY TYPE OF MACHINE

(in thousands of dollars)

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<td>602</td>
<td>882</td>
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<td>110</td>
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<td>592</td>
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<td>314</td>
<td>392</td>
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<td>632</td>
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Source: D.N.E.I., on the basis of the sectorial survey and L.N.PWA.I. quoted in "The Machine Tool Industry", POZZO, year 1971, from the study by DGFM.
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<th>Year</th>
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<th>Value (in thousands of dollars)</th>
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TABLE 5

ARGENTINE EXPORTS BY RECEIVING COUNTRY

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Source: External trade yearbook, Year 66/73, INDEC.
TABLE 6

TOTAL IMPORTS OF MACHINE TOOLS

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<td>797</td>
<td>13 111</td>
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<tr>
<td>1967</td>
<td>1058</td>
<td>11 275</td>
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<td>2816</td>
<td>28 727</td>
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<td>933</td>
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<td>1973</td>
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### TABLE 7

**APPARENT CONSUMPTION OF MACHINE TOOLS**

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<th>Imports as % of apparent consumption*</th>
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* Team's own elaboration.
TABLE 8

PRODUCTION VALUE OF METAL PRODUCTS, MACHINES AND EQUIPMENT; I.G.P.; AND MACHINE TOOLS

(in index numbers 1960 = 100)

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<td>100</td>
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<td>139</td>
<td>141</td>
<td>151</td>
<td>168</td>
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<td>49</td>
<td>70</td>
<td>111</td>
<td>83</td>
<td>69</td>
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</table>

Source: Team's own elaboration

TABLE 9

PERCENTAGE VARIATION OF PRODUCTION VALUES OF METAL PRODUCTS, I.G.P. AND MACHINE TOOLS (%)

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<td>-</td>
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<td>+14</td>
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<td>+59</td>
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</table>

Source: Team's own elaboration