

**THE ECONOMIC STRUCTURE OF THE ORGANIZED SECTOR
OF THE MACHINE TOOL INDUSTRY IN INDIA**

BY

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The machine tool industry, "building machines to build machines," occupies a key position in the industrial development of the country. This study of this industry does not deal exhaustively either with the technological aspects of machine tool manufacturing, or the overall problems of nation's economic development. The study rather gives a balanced and relatively comprehensive analysis of the factors and conditions which have affected the industry in the past and are likely to influence its future development. It is centered on the organization and performance of the organized sector of the machine tool industry and does not attempt the evaluation of the role of machine tool making in the total industrial picture or a very extensive treatment of inter-industry relationships.

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THE ECONOMIC STRUCTURE OF THE ORGANISED SECTOR OF
THE MACHINE TOOL INDUSTRY IN INDIA

INTRODUCTION

This study represents an effort to fill an important gap in the economic studies of Indian industries. The Machine Tool Industry is one of the key industries in the country. Although, a few articles, pamphlets and government reports have been published dealing with its history¹ the rationalisation programme,² demand forecasts,³ a single company,⁴ no comprehensive examination of this industry is available.

The areas reviewed follow the familiar pattern of industry studies. These areas are, the history of the growth of the machine tool industry [Chapter 1] the discussion of physical, financial and human resources, [Chapters 2, 3, 4, 6 and 7], the pricing

¹ (a) Government of India, Ministry of Industry and Supply, Report of the Machine Tool Panel, Delhi, 1949; (b) S.M. Patil, A Case Study of Indian Machine Tool Industry, Report submitted to United Nations, ECAFE, 1959; (c) Bharat C. Doshi 'Progress and Problems of Machine Tool Industry' Financial Express, 22nd January 1968.

² (a) Kalelkar B.D., 'A Review of the Machine Tool Industry, Development Wing, New Delhi, 1961; (b) Government of India, Final Report of the Machine Tool Committee, New Delhi, August, 1958

³ (a) National Council of Applied Economic Research, Demand for Machine Tools, New Delhi, 1965; (b) Government of India, Planning Commission, Report of the Working Group on Machine Tools (Group VI-July 1964, New Delhi, 1964);

⁴ (a) 'Mysore Kirloskar's Steady Progress' Financial Express April 15th, 1967; (b) S.M. Patil, 'HMT—10 Years of Progress' Machine Tool Engineer, Bangalore, Vol. 5 No.3, July-September 1964

policies and methods of marketing [Chapter 5], capacity-utilisation [Chapter 8], past and future demand and the supply [Chapter 9], and the examination of the government policies towards the growth of the machine tool industry [Chapter 10].

The machine tool industry is of a comparatively recent origin. Though started at the beginning of this century in a small way, the growth of the machine tool industry in the organised sector began in the early years of the Second World War. There is now a widespread awareness of the substantial growth experienced by this industry during the past twenty-five years, but this process of growth has not been a continuous one. Periodic interruptions have occurred in response to cyclical pressures. The discussion of the factors impeding or speeding up the process of growth along with the development of the machine tool industry in terms of growth in indigenous production vis-a-vis imports, form the subject matter of Chapter 1.

The discussion in Chapter 2, of the manufacturing processes involved in the making of machine tools, equipment installed in the plant and materials used, is intended to convey to a non-technical reader, an idea of the technology of machine-tool-making. The discussion is also expected to be useful as a background material for the topics analysed in Chapters 3 and 8. The factories combine the well-worn equipment along with the most sophisticated types. In the early years most of the equipment was imported from Great Britain, and only simple types were made in India. In the

last decade, imports of machine tools from Eastern European countries and USSR have increased along with the indigenous production of more advanced types.

In Chapter 3, the input and capital coefficients for the four machine tool firms as well as for the industry as a whole are examined. These coefficients have numerous limitations. The differences in the products of individual firms, the changes in the product-mix of the same firm as well as different technologies in different firms lead to variations in coefficients. The industry coefficients are weighted in favour of a few major firms which accounts for the bulk of the output of indigenous machine tools. The examination of input and capital coefficients is followed by the analysis of the cost structure of four of the firms. Due to the paucity of useful data on costs, meaningful conclusions are difficult to derive.

The financial performance of some major machine tool companies from 1956 onwards is analysed in Chapter 4. The assets and sales of all these companies increased substantially during this period. The companies, however, reacted to the same economic environment differently. The rates of return and turnover ratios are different for different companies. The extent to which profits have not been distributed to shareholders and hence have been available for reinvestment is noted. The changes in the capital-structure of the companies are studied. Also are studied the ways in which the companies obtained and used their funds.

The Chapter 5 begins with the description of the way in which the prices of machine tools are set by manufacturers. There

is a great diversity of products which defies classification. No theoretical rules seem to exist regarding the price setting. The analysis leads to the discussion of the nature of the machine tool market, the degree of competition and the channels through which the products are marketed. There is a great scope for manufacturers to differentiate the products. Thus the weapon of price-cutting is almost ineffective in stepping up the sales. The non-price competition regarding the special design features, quality and rapport with the customers, assumes greater importance. In the context of marketing channels, the existing system of sole selling agency is critically discussed as far as it inhibits the development of better of newer designs. The steps taken up by the Government to restrict foreign competition and to 'protect' the market for indigenous manufacturers are noted. The balance of the chapter is concerned with the problems of exploring export markets for Indian machine tools.

In developing countries, the problem of transformation of labour force with its agricultural origins and attitudes, low levels of literacy into a competent industrial labour force is an important one. The Government and manufacturers have become aware of training the skilled labour force. The labour legislation for workers has gone a long way towards easing the life of workers. The implications of these changes have been considered in Chapter 6, following the discussion regarding the nature and composition, absenteeism and turnover, productivity, unionism of machine tool factory workers.

In Chapter 7, an appraisal is made of the growth of the

machine tool industry in terms of histories of development of six machine tool companies. Upto 1955-56 the companies in the private sector dominated the industry. Beginning with 1955-56, a new pattern is emerging with companies in the public sector, especially H.T., taking the initiative and lead in the development of the indigenous machine tool industry. The entrepreneurs responsible for the growth of these companies, performed numerous functions such as business promotion, capital-provision and risk bearing, technical adaptation and management, though they can hardly be called entrepreneurs as envisaged by Schumpeter, who were expected to undertake only the pioneering activities.

In Chapter 8, the aspects of capacity utilisation in machine tool firms are studied on the basis of detailed data from two companies. The discussion of capacity utilisation leads to the necessity of conceptualising a measure of capacity in multiproduct firms (such as those producing machine tools), and a measure of the imbalance of the capital equipment installed. The technique of Linear Programming is used to indicate the extent of capital imbalance and the utilisation of capacity by pointing out excess capacity per machine group.

The analysis of the past demand of machine tools is made in Section I of Chapter 9. The relative importance of imports, indigenous production and exports of machine tools and changes in the composition of past demand for machine tools are noted. A particularly important issue has been the estimate of demand for machine tools in near future. In Section II of the same Chapter, two available estimates are critically examined and the supply position of machine tools is

discussed in the context of the recession in the machine tool industry.

The development of the machine tool industry in India has greatly been facilitated by favourable policies of the Government. Of greater significance to the growth of the industry are the import control policies aimed at restricting the foreign competition, the licensing policies aimed at controlling and directing the development of various types and sizes of machine tools, the policies towards research and development aimed at developing new designs and standardisation of parts. Equally important is the decision of the Government of India to enter the field of machine tool building as a major producer of machine tools. The Chapter 10 is mainly concerned with the examination of favourable and unfavourable aspects of these policies for machine tool-making in India. In the balance of the chapter, the role of the Indian Machine Tool Manufacturers' Association and the Development Council for Machine Tools in analysing and solving the problems of the industry, is noted.

Finally in Chapter 11, some salient features of this study are highlighted.

At the beginning of this project the idea was to study only the aspects of input-structure and capacity utilisation in the machine tool and allied industries. It was realised after sometime that very much detailed data in the required manner for such an effort would not be available. The decision to make a comprehensive study of the machine tool industry was taken at a request from the Investa Machine Tools, Poona for an outsider's view of the economies

: 7 :

**of the Indian Machine Tool Industry against which the company
could measure its own performance.**

CHAPTER 1THE HISTORY OF THE MACHINE TOOL INDUSTRY IN INDIA*

Machine tool manufacturers hardly existed in India before the Second World War. Some machine tools were made by firms in North India to meet their own special requirements but on the whole the firms manufacturing engineering products, purchased new or secondhand machine tools manufactured in foreign countries.¹ It was only about 1935 that a few leading firms in India turned their attention to the manufacture of machine tools. For example, the Cooper Engineering at Satara Road (Bombay Presidency) and the Batala Engineering at Batala (Punjab) commenced the manufacture of cone-pulley lathes and secured a ready sale in the market. These firms had to face various difficulties in producing machine tools. They did not have a plant for building machine tools of modern type, to a high standard of accuracy and output. They lacked the necessary instruments and inspection equipment required for carrying out the geometrical and practical tests to ensure the right standard of efficiency and durability.

* The method followed in doing the research for this study in Indian Machine Tool Industry is given in Appendix 1.1 attached at the end of this Chapter.

¹ Government of India, Ministry of Supply and Industry. The Report of the Machine Tool Panel, New Delhi, 1949, p. 3.

Indigenous labour was not sufficiently trained for the manufacture of machine tools requiring precision.¹ The greater portion of the machine tools required in the country was imported. In 1937-39, the cost of these imports amounted to about Rs. 32 lakhs out of which the share of the United Kingdom was about 64 per cent.²

It is suggested that the Great Britain, in a sense, 'protected' the Indian market for machine tools for their own home producer. Prof. Baldwin writes, "Although the old Indian Government used to invite 'public bids' for tools for its railway workshops and ordnance factories, the detailed specifications were so tailored for particular machines that they could only be supplied by a particular British manufacturer, as though the specification read, 'We invite the specifications for the supply of Alfred Herbert presses'. Alfred Herbert got a lot for this business."³ There were no protective duties or other restrictions on imported machine tools, and it is doubtful whether the indigenous manufacturers could have successfully competed with the manufacturers in advanced countries.

1 Government of India, Ministry of Supply and Industry. The Report of the Machine Tool Panel, New Delhi, 1949, p.3.

2 Government of India. Annual Statement of the Foreign Sea-borne Trade of India 1938-39. Delhi.

3 George B. Baldwin. Industrial Growth in South India : Case Studies in Economic Development. The Center for International Studies, Massachusetts Institute of Technology, 1959, p. 150.

The Second World War Years¹

The collapse of France in the West and the subsequent hostilities in the East created difficulties in the import of machine tools from abroad. It was necessary to utilize what scanty resources existed in the country. The Machine Tool Control Order was brought into force by the then Indian Government early in 1941. Its officers got in touch with firms like Cooper Engineering Ltd., Satara Road; Jessop and Co.Ltd., Calcutta; Mysore Kirloskar Ltd., Harihar and others, who had already commenced the manufacture of machine tools and were thinking of expanding their activities. In addition, efforts were made to interest in this manufacture, a number of other firms, which had been manufacturing other allied articles. Majority of these firms were encouraged to begin by building simple types of machine tools such as centre lathes, shaping and drilling machines, presses and hacksaw machines. Government licences were freely granted to all firms who expressed their willingness to build machine tools. In the early stages the response from the Engineering Industry was rather unsatisfactory as there was then a general apathy to launch new enterprise when there was plenty of war work of a remunerative nature to be done. The production of machine tools in India rose to about 150 per month by the end of 1942.

¹ The description of the situation of the machine tool industry during War Years is based on The Report of the Machine Tool Panel, op.cit.

They were, however, low down the scale both in grade as well as in quantity. Arrangements were made to import the necessary balancing plant, and instruments for inspection equipment required by the leading firms undertaking this manufacture. In addition a team of about half-a-dozen machine tool experts were brought out from England just to help the indigenous machine tool industry with technical advice and guidance. Under the direction of the Director General, Munitions Production, Department of Supply, Government of India, test charts for various types of machine tools were formed and specific standards laid down for the manufacturers, so that the products could be conveniently graded according to the accuracy of the manufacture.

The progress of the indigenous machine tool industry during the War years, was, to a considerable extent, due to the supervision and direction of the Machine Tool Controller, who was entrusted during the period with full responsibility for providing machine tools required by the Government and the public. All requisitions of machine tools had to pass through him. The manufacturing capacity in the country was utilized to the full, and the balance of machine tools was imported. The result was that each manufacturer received, what was called 'a bulk order' in advance and sold all the machines, he could manufacture, against that order. As the market was assured for him in advance, he was relieved of all anxiety in connection with the marketing of his products and was in addition being assisted in raising the grade and the

general standard of his manufacture, by the technicians employed by the Machine Tool Controller and the Indian Stores Department Inspectors.

The extent of progress made by the industry during the period of the Second World War can be seen from the figures of indigenous production in Table 1.1. The indigenous production of machine tools which was almost nil in 1941, increased to Rs. 111.66 lakhs in 1945, its share in the total domestic consumption of machine tools, being 38 per cent in that year.

The Immediate Post-War Period

During the War period, at one point of time, the Axis-Powers threatened to capture the Suez Canal, with the result that supplies from the United Kingdom to India would have been either cut off or delayed. After 1943, however, the victory for the Allied Powers was in sight, imports of machine tools from the United Kingdom to India continued in increasing amount. With the termination of hostilities, the bulk orders disappeared. The indigenous manufacturers had to sell their products in the open market, where the competition from the imported items was considerable. Some of the imported machine tools were advertised for sale at a price, which was lower than or approximately the same as that in the pre-war period.¹ The controls on imports which were imposed after the abolition of bulk orders were removed in 1948, when machine tools were

¹ Report of the Machine Tool Panel, op.cit., p. 11.

Table 1.1 : Imports and Indigenous Production of Graded Machine Tools in India

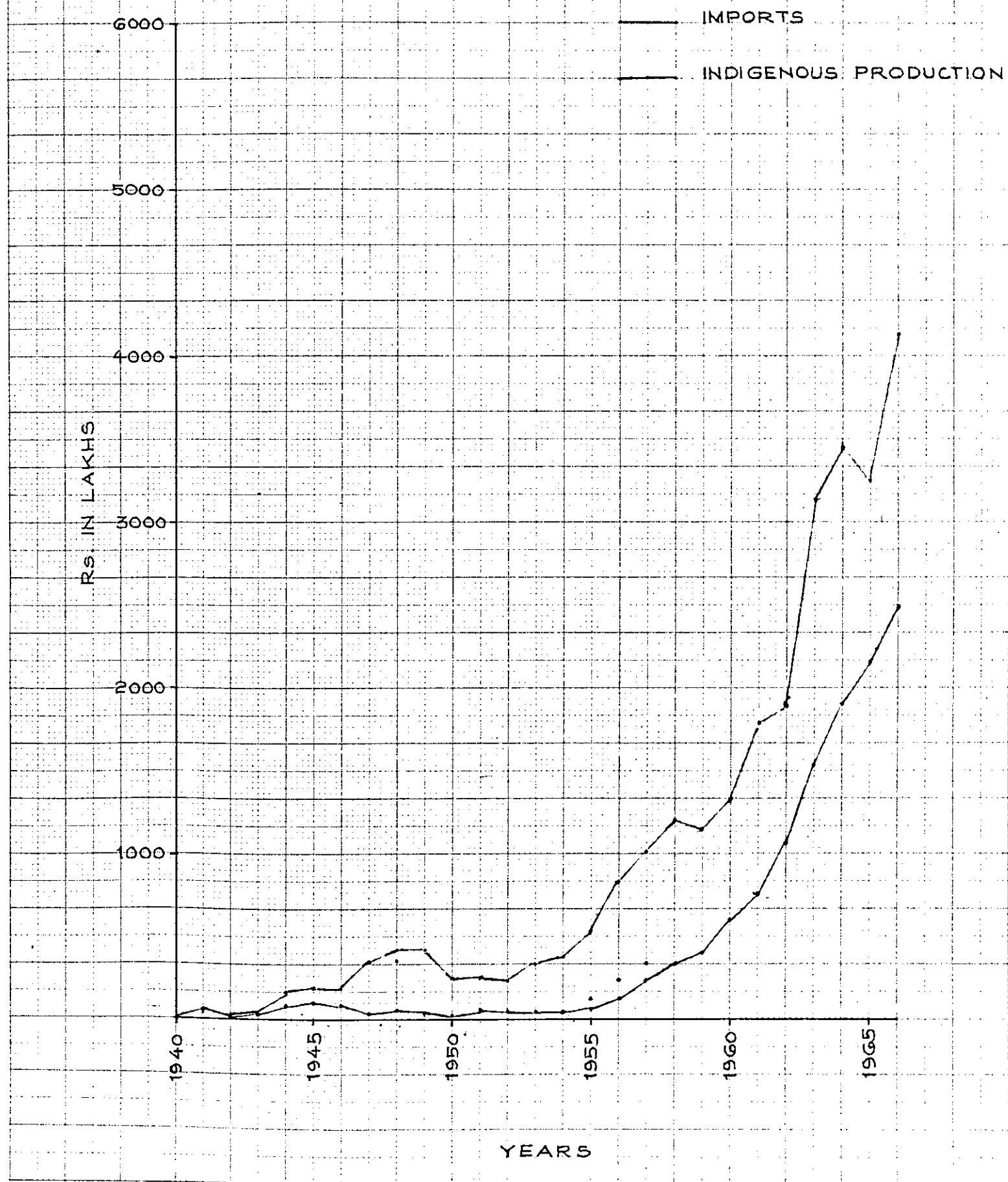
Year	Imports Value (Rs. in Lakhs)	Indigenous Production		Total consumption Value (Rs. in Lakhs)	Percentage of Col. III to Col. I	Percentage of Col. I to Col. IV	Percentage of Col. III to Col. IV
	I	No.	Value (Rs. in Lakhs)	IV	V	VI	VII
1941	68.42	N.A.	N.A.	68.42		100	0
1942	56.98	273	6.07	63.05	11	90	10
1943	53.66	1,713	63.58	117.24	119	46	54
1944	157.70	2,170	77.80	235.50	49	67	33
1945	181.98	3,699	111.66	293.64	61	62	38
1946	183.24	2,820	91.25	274.49	50	67	33
1947	367.62	1,400	45.87	413.49	13	89	11
1948	414.40	1,691	54.72	469.12	13	88	12
1949	419.59	2,240	47.29	466.88	11	90	10
1950	249.01	1,130	28.50	277.51	12	90	10
1951	250.00	2,834	47.31	297.31	19	84	16
1952	221.13	2,660	44.37	265.50	20	83	17
1953	312.71	2,640	44.08	356.79	14	88	12
1954	386.40	1,544	47.13	433.53	12	89	11
1955	528.97	3,064	68.88	597.85	13	88	12
1956	837.28	3,016	108.18	945.46	13	89	11
1957	1131.69	4,033	234.78	1366.47	21	83	17
1958	1210.70	5,465	340.77	1551.47	28	78	22
1959	1160.86	4,434	416.30	1577.16	36	74	26
1960	1320.92	5,332	618.80	1939.72	47	68	32
1961	1789.00	8,511	775.80	2564.80	43	70	30
1962	1895.00	10,293	1088.20	2983.20	57	64	36
1963	3150.61	11,058	1543.80	4694.41	49	67	33
1964	3444.41	13,370	1891.60	5336.01	55	65	35
1965	3258.56	15,423	2225.64	5484.20	68	59	41
1966	4103.93	14,769	2491.27	6595.20	61	62	38

Figures from 1941 to 1961 also include other metal working machinery in addition to machine tools. The proportion of metal working machinery to the total indigenous production is very insignificant in earlier years and increases to about 8 per cent in 1961.

Sources: (1) Production figures were collected from the Indian Machine Tool Manufacturers' Association, Bombay.

(2) The figures of imports are extracted from Annual Statement of the Foreign Sea-Borne Trade of India, Delhi (Government of India Publication) for the appropriate years prior to 1955-56. Imports figures from 1956 through 1966 are taken, for the appropriate years, from Monthly Statistics of the Foreign Trade of India, Vol. II - Imports (Government of India, Department of Commercial Intelligence and Statistics, Calcutta.)

FIG.1.1 THE IMPORTS VERSUS INDIGENOUS PRODUCTION OF GRADED MACHINE TOOLS



put under Open General Licence, as a result of the General Agreement on Tariffs and Trade at Geneva.¹ The competition from imports became severe (the U.S.A. and U.K. having dumped their surplus war production in India), with the result that many firms went out of the business; while some took up other product lines.²

The machine tool industry in India had to face a severe competition from foreign manufacturers, who had built up considerable financial resources and commanded high technical experience. They had well established service agencies in India, which had been in intimate contact with the consumers for a long time and had rendered good service to them in the past and were expected to have, therefore, continued patronage for their products. The machine tool builders in India, on the other hand, suffered from serious handicaps on these counts. They had not yet attained that long established reputation for high quality workmanship which creates confidence among the consumers. The difficulties and handicaps were inevitable in an under-developed country, but they are further accentuated in the case of machine tool industry, by the fact that the efficiency of a workshop depends, to a large extent, upon the efficient

1 Industrial Growth in South India, op.cit., p. 151.

2 S. M. Patil. A Case Study of Indian Machine Tool Industry. Report submitted to the United Nations Economic Commission for Asia and the Far East (mimeographed - unpublished), 1959, pp. 4-5.

performance of the machine tools installed therein. Naturally, the manager or the foreman of the shop, responsible for maintaining a high standard of production would, if left a free choice, naturally install in his shop machine tools made by manufacturers of repute in foreign countries, which have stood the test of time and given satisfaction in the past, in preference to machine tools built by local manufacturers, who came into existence only during the last few years, and who could not be said to have acquired that knowledge and the standard of technique which comes from long experience. Similar preferences existed for steel, cement and other materials of foreign manufacturers when the indigenous products came on the market. In the case of cement or steel, however, tests for determining the comparative efficiency of the indigenous products were easy to make. Consequently, the preference for articles of foreign manufacturers was short-lived. Indian machine tool manufacturers were further handicapped by the fact that no standard specifications for their machine tools, as in the case of steel, cement or a number of other articles were available for guidance or test. The factual data could persuade a hesitant customer in the case of cement or steel, even though the firm manufacturing the items is newly established. Such data were not available to the indigenous machine tool manufacturer to push up his sale.

The extent of the debacle can be seen from the figures

of indigenous production of machine tools presented in Table 1.1. The indigenous production dropped down from Rs.91 lakhs in 1946 to Rs. 28.5 lakhs in 1950. Imports continued to increase reaching up to Rs. 420 lakhs in 1949. From 1948 through 1950, the machine tools indigenously produced, amounted only to about 11 to 13 per cent of the total consumption of machine tools in India.

In view of this collapse and out of the concern for the development of the machine tool industry a number of committees were set up by the Government of India at this time. A brief account of the major recommendations of the Stanier Mission, known as the War-Disposal Utilisation Committee, and those of the Machine Tool Panel Report, are given below.

In February 1948, the Ministry of Industry and Supply set up a War-Disposal Utilisation Committee to recommend the use of the huge quantity of war-disposal plant, machinery and scientific apparatus available with the Director General of Supplies and Disposals.

One of the major recommendations of the Committee was that a substantial portion of the machine tools available should be used for the establishment of three new production units in the country, one of which was to be a factory for building machine tools.¹

¹ The text of the original report was not available. The summary of the recommendation has been taken from S. K. Patil's A Case Study of Indian Machine Tool Industry, op.cit., p. 2.

In accordance with this recommendation, the Government of India, in February 1949, entered into licence manufacturing agreement with a Swiss firm, Messrs Oerlikon Machine-Tool Works Buehrle & Co., Zurich, for the production of precision machine tools at the Hindustan Machine Tools, Bangalore.

The Report of the Machine Tool Panel, published in 1949, recommended that the maximum priority should be given to the machine tool and small tools industries while allocating raw materials, that the Machine Tool Controller should prepare specifications for materials, tolerances and performance with according to those adopted by manufacturers abroad, and that the costly materials like high speed steel, non-ferrous metals should be made available to indigenous manufacturers at prices comparable to those in the United Kingdom. The Panel also recommended that training facilities for workers and technical staff needed in the machine tools should be provided in some of the ordnance factories and that the services of experts from advanced countries be utilized.¹

In 1947, the manufacturers of machine tools had submitted an application to the Government of India for protection and assistance to the machine tool industry. The Government referred the matter to the Tariff Board. The Tariff Board came to the conclusion that the best way to protect the machine tool industry would be through import restrictions

1 Report of the Machine Tool Panel, op.cit., pp. 17-19.

rather than through high tariffs. The views of the Panel Report were similar to those of the Tariff Board. The Panel felt that any high incidence of duty levied on imported machine tools would have a deterrent effect on the industrialization of the country as the cost of capital equipment would go up considerably. Practical difficulties of imposing protective duty were also considered. Hence a total ban on imports of such machine tools as were indigenously produced was advocated.¹

The reports of the Committees and their recommendations indicate that the importance of the machine tool industry for the industrialization of the country was noted and positive thinking to devise ways and means for the development of this industry had started. The rapid development of the machine tool industry which followed during later years, is due partly to the particular policies of the Government towards the development of this industry, though the main impetus to the development was received from the quicker pace of industrialization during the Five Year Plans.

The Progress during the Period of the Five Year Plans

At the beginning of the First Five Year Plan period, in 1950, there were 14 manufacturers of graded machine tools in India and their total rated capacity was about 3000 machine tools per annum, valued at about Rs. 90 lakhs. Out of these

1 Report of the Machine Tool Panel, op.cit., pp. 17-19.

14 factories, five were located in the State of Bombay, four in West Bengal, two in Delhi, one each in Mysore, Hyderabad and East Punjab. The total number of persons employed was about 1500.¹

The range of products of the industry included mostly cone-pulley lathes, drilling machines, shaping machines, planing machines, chucks and other miscellaneous general types. The major customers were Indian Railways, Defence Services and other government agencies, which together accounted for half the total demand in the country.² The indigenous production, according to the Planning Commission was 'not found to be suitable for Class I Railway Workshops, Ordnance Factories and certain other key industries' which demanded more advanced types of precision machinery.³ The Planning Commission envisaged a capacity production of 4600 graded machine tools per annum by 1955-56,⁴ though by the end of 1956, the actual indigenous production was only 3064 numbers as can be seen from Table 1.1, the share of indigenous production of the total requirements being only 13 per cent during that year.

1 The Government of India, Planning Commission. Programmes of Industrial Development 1951-56. Delhi, pp. 55-56.

2 Ibid, p. 56.

3 Ibid, p. 54.

4 Ibid, p. 60.

The demand for a greater quantity of machine tools, especially of advanced types was expected to materialize during the Second Five Year Plan, with increasing stress on the development of industry in general and steel and heavy engineering industry in particular. Thus it was necessary to have a well developed machine tool industry at the earliest.

The Engineering Capacity Survey Committee of the Government of India in 1954, had pointed out to the need for more rapid development of the machine tool industry and had recommended to the Government that as a first step a census of machine tools installed in the country may be taken up.

To guide the Government to take the further necessary action, the Machine Tool Committee (known as Thacker Committee, after its chairman, Prof. Thacker), consisting of representatives of manufacturers, users, the Development Wing and officers of the concerned ministries, was set up in 1954. The Committee recommended the creation of new units for sheet-metal and wood working machine tools, provision of training for machine tool designers, standardization of machine tool requirements, the creation of Machine Tool Board,¹ etc.

The Committee felt that, though the overall demand was quite considerable, the demand for different types, the manufacture of which could be undertaken economically during

¹ The Government of India, Ministry of Heavy Industries, Development Wing. Final Report of the Machine Tool Committee. New Delhi, August 1958.

the Second Five Year Plan, was limited. It was not thought feasible to have a large number of units, manufacturing the same items competing with each other. Thus the Committee recommended a rationalization of production programme to the major units in the country, according to which a particular unit was to specialize in a particular item.¹ Nevertheless, the pace of development at the end of the First Plan was stepped up so rapidly during the Second Five Year Plan, that the estimate of demand made by the Thacker Committee was found to be quite conservative; and the attempts by the Committee to restrict competition by its plan of rationalization of production programme, resulted in conferring more or less monopolistic positions to the major units, regarding certain items.² In 1959, this policy was discontinued, when the Development Council recommended to the Government of India that the policy of monopolistic assignment of responsibility of developing a particular type of machine tool by an individual unit should be changed.

From the beginning of the Second Five Year Plan period, the Government of India entered the machine tool manufacturing in a big way. The collaboration agreement with Messrs Oerlikon Machine Tool Works, Switzerland, was concluded in 1949, for

1 Final Report of the Machine Tool Committee, op.cit.

2 B. D. Kalelkar, Industrial Adviser, Development Wing. A Review of Machine Tool Industry. Development Wing, New Delhi, January 1961 (Mimeographed - unpublished), p. 2.

the establishment of the Hindustan Machine Tools at Bangalore, but the production started only by 1955-56. The HMT has been substantially expanded during the last decade. There are units in Bangalore known as HMT I and HMT II which were commissioned in 1955 and 1961 respectively. The unit at Pinjore in Punjab, known as HMT III was commissioned in October 1963, a unit at Kalamassery in Kerala was commissioned in 1964 and a unit at Sanatnagar in Hyderabad commissioned in 1965. It was envisaged in 1964-65 that 10 HMT factories in different parts of the country will go into full or partial production by 1970-71, accounting for a capacity of Rs. 50 crores per year by the end of the Fourth Five Year Plan. The Government of India became a majority shareholder in Praga Tools Corporation Ltd., at Hyderabad in 1958. The Government Machine Tool Factory at Ambarnath specialized in the manufacture of prototypes of new machine tools, though there has been negligible production of machine tools from this factory for civil use during the last few years, as it caters mostly to the Defence needs.

The Government of India has set up in the public sector a Heavy Machine Tools factory at Ranchi in collaboration with Czechoslovakia. The factory was expected to be commissioned in 1966.

By 1964, the total number of units approved for manufacture of metal-cutting and metal forming machine tools

was 111, out of which 107 units were in the private sector.¹

The Statewise distribution of these factories is given in Table 1.2.

Table 1.2 : The Statewise Distribution of Machine Tool Companies Manufacturing Graded Machine Tools in 1964-65

State	No. of companies	Per cent to the total
Andhra Pradesh	2	2
Bihar	2	2
Delhi	2	2
Gujarat	9	8
Kerala	1	1
Madhya Pradesh	1	1
Madras	11	10
Maharashtra	36	32
Mysore	5	5
Orissa	2	2
Punjab	17	15
Uttar Pradesh	2	2
West Bengal	21	18
Total	111	100

Source: 'List of Industrial licences issued for manufacture of machine tools,' Demand for Machine Tools, National Council of Applied Economic Research, New Delhi, August 1965, pp. 136-148.

¹ The data regarding the number of manufacturers and Statewise distribution are taken from 'List of Industrial Licences issued for Manufacture of Machine Tools,' - an appendix in the book Demand for Machine Tools published by the National Council of Applied Economic Research, New Delhi, August 1965, pp. 136-148.

Of these units 55 units had been actually producing machine tools in 1964. The remaining firms, though they were licensed to manufacture machine tools, had not yet started production. The total licensed capacity of all the units was of the order of approximately 39,000 numbers of machine tools valued at Rs. 35 crores per year.¹ HMT accounted for about half the total licensed capacity for machine tools.

During the Five Year Plans, the growth of machine tool industry has been spectacular. The production of graded machine tools was Rs. 2491 lakhs in 1966, about 53 times the production in 1951. By 1966, the capacity in the organized sector was for Rs. 36 crores, 66 per cent of this capacity was in the public sector, the rest being in private sector.

The recessionary tendencies in the Indian economy from 1965 onwards affected the machine tool industry during the last three years. Though the absolute amount of production in 1966 had increased, the rate of increase had slackened.

The Small-Scale Unorganized Sector of the Machine Tool Industry

Small-scale units, especially in Punjab and Delhi manufacture ungraded machine tools. The items of machine tools produced in this sector are simple types of lathes and drills, milling machines, shapers and manual presses. The Statewise distribution of small units in India as in 1962 was as follows.

¹ National Council of Applied Economic Research. Demand for Machine Tools. New Delhi; August 1965, p. 39.

Table 1.3 : The Statewise Distribution of Small Units in the Unorganized Sector in 1962

State	No. of units	Percentage to the total
Andhra Pradesh	-	-
Bihar	2	-
Delhi	12	3
Gujarat	30	9
Kerala	-	-
Madhya Pradesh	6	2
Madras	14	4
Maharashtra	6	2
Mysore	4	1
Orissa	-	-
Punjab	250	71
Uttar Pradesh	-	-
West Bengal	28	8
Total	349	100

Source : Figures based on the survey conducted by the Central Small Industries Organization, Ministry of Commerce and Industry, Government of India, as quoted in R. V. Ramiah's "Manufacture of Machine Tools in India," Machine Tool Engineer, Vol. IV, No. 3, Bangalore; July-September 1963, p. 24.

The production and installed capacity in the unorganized small scale machine tool sector in 1961-62 was about 20,313 and 37,719 numbers respectively. ¹

There are several reasons for the growth of unorganized machine tool industry. The restrictions on the imports of indigenously produced simple types of machine tools resulted in a shortage of graded types during the Second and Third Plan years. The small units could try to fill this gap. The main reason, however, is to be found in the lower prices of ungraded machine tools as compared to those of graded ones. The demand for the products of the unorganized sector comes mostly from the small engineering workshops, which with their meagre financial resources prefer the low priced ungraded machine tools to graded types. However, the manufacturers in the organized sector producing medium and heavy types are not involved into competition with small units, as both sectors operate in almost entirely different markets. Some of the units in unorganized sector have, in recent years, started manufacturing the graded machine tools.

The Machine Tool Industry in the Indian Manufacturing Sector

The most recent data which show the relative sizes and rankings of industrial groupings in India are those of 1963, Annual Survey of Industries. In the five years between 1963

¹ Figures from the survey of Central Small Industries Organization, as quoted in NCAER's Demand for Machine Tools, op.cit., p. 41. The figures refer to the production of lathes, drills and milling machines only.

and 1968 expansion has taken place in the Indian industry with different rates of growth for different industries, making the data of the earlier years obsolete. The data remain useful, however, to indicate the position of the machine tool industry in the manufacturing sector in the year 1963, as shown in Table 1.4 viewed in its relationship with total manufacturing sector, the machine tool industry looks rather small, despite its position in industrialization of the country.

Table 1.4 : Machine Tool Industry in the Indian Manufacturing Sector

Item	Total manufacturing sector I	Machine Tool Industry ^{a/} II	% of Col. II to Col. I III	Rank in 205 industries IV
Total output (Rs. in Thousands)	45,878,351	170,314	0.37	49th
Total employment (In numbers)	3,289,151	15,820	0.48	37th
Total productive capital (Rs. in Thousands)	34,606,481	225,735	0.65	32nd

^{a/} Total 47 factories.

Source : Government of India, Central Statistical Organisation, Department of Statistics, Cabinet Secretariat. Annual Survey of Industries, 1963, Vol. 1, Calcutta; pp. 3 and 89.

Indian Machine Tool Production in the World Perspective

Viewed in its relationship with world machine tool manufacturing also, the Indian machine tool industry looks rather small, as is seen from Table 1.5. Its production of 53 million dollars in 1965 may be compared 1458 million dollars for U.S.A., 840 million dollars for West Germany or even with 268 million dollars for Japan. Among 28 nations India ranks 14th in the machine tool production, but manufactures only 1 per cent of the total machine tools produced in these countries.

Having discussed the growth of Indian machine tool production in the preceding pages, the examination of raw materials and equipment used by the Indian machine tool manufacturers is made in the next chapter, following the description of the manufacturing processes involved in the production of machine tools.

Table 1.5 : Production, Exports and Imports of Machine Tools (for Some Selected Countries) 1965

(Figures in Million U.S.Dollars)

Country	I Production	II Percentage to the total of Column I	III Exports \$	IV $\frac{\text{Col. III}}{\text{Col. I}} \times 100$	V Imports \$	VI $\frac{\text{Col. V}}{\text{Col. I}} \times 100$
1) United States	1457.6	28.7	240.6	16.5	56.3	3.9
2) West Germany	840.3	16.5	400.0	47.6	97.0	11.5
3) Soviet Union	782.0	15.4	44.0	5.6	119.0	15.2
4) Great Britain	393.7	7.8	136.2	34.6	94.0	23.9
5) Japan	268.2	5.3	35.7	13.3	51.1	17.7
6) France	226.4	4.4	62.7	27.6	88.1	38.9
7) Czechoslovakia	215.0	4.2	129.0	60.0	47.0	21.9
8) East Germany	164.0 ^{a/}	3.2	82.0 ^{a/}	50.0	25.0 ^{a/}	15.2
9) Switzerland	140.0 ^{a/}	2.8	119.0	85.0	38.0	27.1
10) Italy	112.0	2.2	80.8	72.1	33.7	30.1
11) Poland	60.0 ^{a/}	1.2	24.0 ^{a/}	40.0	39.0 ^{a/}	65.0
12) Spain	58.0	1.1	7.5	12.9	26.0	44.8
13) Sweden	53.0	1.0	28.5	53.8	50.2	94.7
14) India	52.5	1.0	0.8	1.5	67.2	128.0
15) Hungary	30.0 ^{a/}	0.6	11.0 ^{d/}	36.7	5.5 ^{d/}	18.3
16) Brazil	30.0 ^{a/}	0.6	2.3 ^{a/}	7.7	55.0 ^{a/}	183.3
17) Australia	29.0 ^{b/}	0.6	2.0	6.9	49.0	169.0
18) Belgium	28.2	0.6	21.8	77.3	30.5	108.2
19) Canada	28.0	0.6	7.0	25.0	96.0	342.8
20) Rumania	26.0 ^{a/}	0.5	2.0 ^{d/}	7.7	25.0 ^{a/}	96.2
21) Argentina	25.8 ^{a/}	0.5	1.5	5.8	7.3	28.3
22) Austria	13.3	0.3	10.1	75.9	16.9	127.1
23) Yugoslavia	12.7 ^{c/}	0.3	7.6	59.8	25.4	200.0
24) Netherlands	12.7	0.3	7.0	55.2	10.1	79.5
25) Denmark	10.7	0.2	7.1	66.4	16.4	153.2
26) Bulgaria	7.1 ^{d/}	0.1	3.5	49.3	7.9	111.3
27) Portugal	2.3	-	0.8	34.8	7.0	304.3
28) Mexico	0.5	-	-	-	9.5	1900.0
Total	5079.0	100.0				

^{a/} - Rough estimate from fragmentary data

^{b/} - Year ended June 30th

^{c/} - Developed from data on weight of machines

^{d/} - Developed from data on numbers of machines

Source : American Machinist, Vol. III, No. 2, 16th January, 1967, p. 131.

APPENDIX 1.1A NOTE ON METHOD

The method followed in doing the research for this study in Indian Machine Tool Industry is given below.

In the course of preparatory work for this study, some three months were spent by the writer in the factories of Cooper Engineering Ltd. at Satara Road and Poona, and Investa Machine Tools Engineering Co. Ltd. at Poona, to acquire knowledge regarding the manufacturing processes involved in the making of machine tools. At the same time, such material as is available on the Indian machine tool industry from the books, reports and newspaper and periodical articles was compiled. On the basis of data thus acquired, a detailed series of questions relating to the structure and growth of the industry to be studied were formulated and outline of the research study prepared. This questionnaire and the outline served as a guide in the search for material from the machine tool units visited.

The machine tool industry in India can be classified into three broad sectors, viz., large firms in (a) the organized public sector and (b) the organized private sector and small units in (c) the unorganized sector, which consists of small workshops manufacturing ungraded types of machine tools. The large firms in the organized private and public sectors manufacture graded machine tools.

In 1964-65, the number of units in the large-scale organized sector licensed for the manufacture of machine tools was about one hundred. Not all of these had started production. Most of those who had been engaged in the machine tool production were also manufacturing other industrial machinery and allied items in addition to machine tools, the production of the latter being, in some cases, less than five per cent of the total output of the firm. A detailed field survey covering all the units was not possible in view of either financial resources or time available.

Most of the production of indigenous machine tools is concentrated in a few large units. Fortunately, most prominent of these units are located in Maharashtra or the neighbouring States, which could be personally visited and studied in detail.

Hence it was decided to study a few major machine tool firms in detail and to send a questionnaire by mail to the rest of the units.

The following nine units were studied in detail.

Name	Location of the factory	Products (types)	Machine tools production in 1964 (Rs. in lakhs approximate)
1. Batala Engineering Co.	Batala (Punjab)	Lathes, planing bandsaws	34
2. Cooper Engineering	Chinchwad, Poona and Satara Road (Maharashtra)	Planing, Shaping, Slotting Vert. turret lathes	75

Name	Location of the factory	Products (types)	Machine tools production in 1964 (Rs. in lakhs approximate)
3. Crescent Iron and Steel Corporation	Lalbaug (Bombay)	Grinders, Bandsaw, machine-vices	27
4. Ex-Cell-O India Ltd.	Thana Bombay (Maharashtra)	Boring, grinders turret milling, lapping, special purpose machines	48
5. Hindustan Machine Tools	Bangalore (Mysore)	Lathes, turrets, automatics, milling, drills, grinders, gear shapers, special purpose machines.	8,61 (Including production of other HMT units)
6. Investa Machine Tools and Engineering Ltd.	Chinchwad Poona, (Maharashtra)	Lathes, drills	75
7. Mysore Kirloskar Ltd.	Harihar (Mysore) Hubli (Mysore)	Lathes, capstans, turrets, hacksaw	3,09
8. New Standard Engineering Ltd. (Machine Tool Division)	Caroli Road Bombay, (Maharashtra)	Drills, hacksaw, plate bending, nibbling, hammers, screw cutting and threading, presses	72
9. Praga Tools Ltd.	Secunderabad (Andhra Pradesh)	Drills, grinders, chucks, vices.	1,06

All the units, except Batala Engineering Co., a major machine tool unit about more than thirty years old, were personally visited. The annual reports and accounts, other information relating to the production facilities of Batala were available from the Secretary, Stock Exchange, Bombay. Additional data relating to Batala were obtained through correspondence with the manager of Batala factory in Punjab.

The combined machine tool production of these nine firms studied, was Rs.1,607 lakhs in 1964 and amounted to about 80 per cent of the total Indian production of graded machine tools in that year.

The visits to the factories were from one week to one and half months in duration. During these visits, data were collected regarding production, employment, methods of marketing, finances etc. These data were supplemented by interviews with department heads, managerial and supervisory personnel and sometimes union leaders. The financial records of the machine tool companies were obtained, in some cases, from the companies themselves and from the office of the Registrar of Companies at Bombay and the Secretary, Stock Exchange, Bombay. The pamphlets and other material regarding the growth were given by some companies.

In addition to the nine firms studied in detail, some other firms, engaged in the manufacture of machine tools were visited and talks with their officials helped to gain a perspective of the problems faced by the industry. These

companies are as follows: Dandekar Machine Works, Bombay; Godrej and Boyce Manufacturing Co., Vikroli, Bombay; Kirloskar Brothers Ltd., Kirloskarvadi; Acme Manufacturing Co., Wadala, Bombay; Ralliwolf Ltd., Bombay; Sonalkar, Harihar, Mysore etc.

A questionnaire seeking information on production, operations, marketing methods, finances, availability of materials and labour, etc. was mailed to 79 members of the Indian Machine Tool Manufacturers' Association, Bombay; out of which 21 units supplied answers to all or few of the questions.

A considerable amount of valuable data was acquired through interviews and correspondence with the officials of the Government and other non-government institutions. These included the Development Wing of the Ministry of Commerce and Industry, Government of India; the Indian Machine Tool Manufacturers' Association, Bombay; the Indian Merchants Chamber of Commerce, Bombay; the Stock Exchange, Bombay etc. A few dealers in machine tools in Bombay such as Batliboi and Co., Perfect Machine Tools Co., William Jacks and Co., etc. were helpful in obtaining the data on the aspects of pricing and marketing of machine tools.

Other historical, financial and statistical records were found in the following libraries. The Servants of India Society Library (Gokhale Institute of Politics and Economics), Poona; the libraries of Indian Merchants Chamber of Commerce, Bombay; Indian Institute of Management, Ahmedabad and the Hindustan Machine Tools, Bangalore.

The study of firms only in the large-scale organized sector is made in this report. The writer is aware that the study of small units in the unorganized sector, mainly located in Punjab, would have added to the value of the study. This did not become possible. A scheduled trip to Ludhiana and Batala in Punjab had to be cancelled because of the outbreak of Indo-Pak conflict in September 1965. Afterwards, because of various reasons, the idea had to be given up. The problems of the unorganized sector, however, are much different than those faced by the units in the organized sector and a separate and deeper study of small scale unorganized sector of the machine tool industry is necessary.

The survey and collection of data for this study were over by the beginning of 1966. A protracted illness, the termination of the tenure of the research fellowship at Poona and taking up of a new job in Ahmedabad, delayed the analysis of data and writing of the final draft, which is now completed by the end of 1968.

APPENDIX 1.2DEFINITION OF MACHINE TOOLS

"Machine tools, often described as 'machines that make machines', are power-driven appliances for precise shaping of metal parts from raw or semi-processed materials, rough castings, forgings or rolled sections, etc. by removing excess metal by cutting. These are essentially capital goods used mainly in the heavy mechanised industries and in the manufacture of locomotives, ships, aeroplanes, radio electronic equipment, agricultural and textile machinery, armaments etc."¹

The Working Group on Machine Tools divides machine tools in two broad categories: (a) Machine Tools, and (b) Other Metal Working Machines. This classification is generally followed in this report. The classification by the Working Group is as follows:²

¹ Programmes of Industrial Development 1951-1956, op.cit., p. 53.

² Government of India, Planning Group on Machinery Industries, Report of the Working Group on Machine Tools (Group VI - July 1964), pp. 51-52.

D.O. (Tools) Code No.	Machine Tools (Group A)
01	Automatics
02	Boring
03	Broaching
04	Drilling
05	Gear Cutting
06	Gear Grinding
07	Gun
08	Honing and Lapping
09	Capstans and Turrets
10	Lathes
11	Milling Machines
12	Planing Machines
13	Presses
14	Sawing
15	Shaping
16/17	Shearing, Plate and Sheet Metal
18	Slotting
19	Screwing
20	Threading
22.15.60	Hammers
22.18.00	Reeling
22.22.00	Tapping
22.23.00	Bending other than Rolls
22.26.00	Polishing
	Machine Tools for Working Metals (NES)

D.O. (Tools) Code No.	Other Metal Working Machines (Group B)
13.11.00	Press Moulding
22.08.00	Die Casting
22.12.00	Forging Machines
22.18.00	Rivetting Machines
22.24.00	Wire Drawing Machines
22.25.00	Core Making Machines
22.34.00	Moulding Machines
	Metal Working Machinery not elsewhere specified
	Drill Chucks
	Lathe Chucks
	Parts and accessories for machine tools
	Portable Electric Drills
	Portable Electric Grinders
	Portable Electric Tools
	Pneumatic Tools
	Wood Working Machinery

CHAPTER 2MANUFACTURING METHODS, EQUIPMENT AND MATERIALSManufacturing Processes

Machine tools are made with machine tools. The making of a machine tool consists essentially of shaping the metal according to the desired specifications and assembling the various parts to form a final product. The shaping of metal, however complex the modern machine tool may become, will be according to one of six basic operations, viz., (a) turning, (b) drilling and boring, (c) milling, (d) shaping and planing, (e) grinding and (f) forging, shearing and pressing.

The main production departments of a typical machine tool factory are: (i) the foundry, (ii) the machine shop and (iii) the assembly shop.

A characteristic of Indian machine tool firms is that most of them have a foundry attached to them. In Western countries, especially in the U.S.A., the machine tool builder with his own foundry, is an exception.¹ It is a common practice to secure identical castings from different sources. The U.S. machine tool builder selects his own source after an evaluation of various considerations, such as price, delivered

¹ Government of India, Ministry of Commerce and Industry. The Report of the U. S. Machine Tool Advisory Group. New Delhi. September 1957, p. 16.

distance from the foundry and the ability of the foundry to continue to provide castings under emergency conditions. The present under-developed state of the foundry industry in India makes the Indian machine tool builder rather to set up his own foundry than to rely on uncertain supply of probably defective castings from others.

(a) The Foundry Operations

The foundry operations consist of stages by which castings are manufactured. Cupola is charged with coke, pig-iron and other chemicals, and is heated. The molten metal is poured into moulds. Rough castings are removed from the moulds after allowing sufficient time for the metal to cool down. After fettling (removing the excess materials by means of hammers and fettling machines) and heat treatment, the castings are sent to the machine shop for machining operations. Rough castings of components requiring not so much precision and toughness are sent directly to the machine shop without heat treatment.

The equipment in the foundry consists of furnaces, cupolas, metal working and wood working machine tools for making patterns, equipment for making moulds, cores, and equipment for fettling.

(b) The Machine shop Operations

The function of the machine shop is to fashion from the raw stock, finished parts by the removal of the excess material. The shop usually receives a blueprint detailing

the dimensions of the part, quantity and a shop order authorizing to fabricate the quantity of parts specified on the order. Often the written method of manufacture accompanies the order. This order lists operations to be performed and indicates the tooling involved--jigs, fixtures, templates, special tools--which help to facilitate the fabrication of parts.

The machinery in the shop includes machine tools such as milling machines, turret and engine lathes, drill presses, grinders, shapers, boring mills, and so on. An assortment of cutting tools, such as drills, a variety of tool bits, milling cutters, taps and reamers is also a part of shop's equipment as well as measuring instruments like rules, calipres, micrometres and gauges.

The material is supplied to the shop in the form of bar stock--round, hexagonal, square, rectangular,--castings, forgings, sheet and plate stock etc. Some parts may come to the shop in a semi-finished state or leave the shop in a semi-finished condition to be further operated upon by other specialized departments. Parts may be rough machined at the shop, go to another department for heat treatment and then be routed back to the shop for finish machining.

Parts are not necessarily fabricated on one machine. They may pass to several machines and through the hands of several operators before they are completed. A part may start on a turret lathe for an operation, go to a milling machine, then to a drill and end up with a grinding operation.

The fabrication of parts is broken down into operations; operations in turn are divided into elements--machining and handling.

A particular operation is not necessarily the function of only one type of machine. It may be one of the functions of several types of machines in the shop. Drilling, for example, is done not only on drill presses but also on engine and turret lathes, milling machines and boring machines. Some machines are better equipped to perform a particular machining operation than another.

The following is the description of more common operations performed by the specialized equipment of the machine shop.¹

Turning and Allied Operations :- The reduction of external surface to some external diameter by means of a pointed tool is called 'turning'. Single pointed tools are held by various types of tool holders such as cutter turners, square turrets, tool posts etc., and are operated from the hexagon turret of the turret lathe or the cross slide of the turret and engine lathes. The following are the operations allied to the turning operation.

Pointing :- The process of removing metal at the end of a bar to facilitate the approach of a cutter turner.

¹ Operations in the machine shop are explained in somewhat detail to facilitate the understanding of the engineering data used for building Linear Programming Model in Chapter 8, which deals with the time inputs of these operations per unit of product.

Chamfering :- The process of removing metal from the edges of external or internal diameters.

Forming :- A method of removing material from stock for producing surfaces that would be difficult to produce by the orthodox methods of facing.

These operations are employed in the modification of the external cylindrical form of the materials.

Boring and Drilling

These operations are used for the modification of the internal cylindrical form of components to be fabricated, and have to do with the removal of material from internal areas through the employment of specialized cutting tools.

The removal of material to produce a hole in a solid is accomplished by drilling. The tool used is called a drill. Drilling operations are performed on drill presses--single and multiple spindle, progressive or radial and turret and engine lathes. In combination with other operations, drilling is done on boring mills and infrequently on milling machines.

The removal of material by a boring tool to enlarge or finish an internal diameter that has been previously cored, drilled or bored is called a boring operation.

Boring operations are performed on boring mills, engine and turret lathes and specialized boring machines. Occasionally, boring is done on milling machines and drill presses. For use on these latter machines, special tooling in the way of

jigs, fixtures, boring heads and bars has been especially designed for the job.

Facing

The process of removing excessive material along some plane on a bar, casting or forging is called 'facing'. The purpose of this operation is to produce a better finished surface than is found in the raw stock and to meet the dimensional requirements.

Facing operations are generally done on planing and shaping machines, and with special tooling on lathes, milling machines (with face milling cutters) etc.

Milling

Milling is a method of removing material from a surface by means of a rotary cutter called a 'milling cutter'. The office pencil sharpener is an example of a specialized milling machine.

Grinding

Grinding is done by a machine employing an abrasive wheel for the purpose of removing excess material. Grinders are used when very good finish is required or where very close tolerances are to be met. Grinding machines for production fall broadly into three classes: external, internal and surface. The work produced is of many types--plain, stepped, form, concave and convex radii, taper, etc.

Forging, Shearing and Pressing

The metal forming machines, used in these operations, are employed, to change the shape of the material in heated

form by hammering or pounding on it, facilitating the economy of the material, while an amount of material is always given as scrap in the use of metal cutting machines which change the shape by the removal of the material. Power presses, hammers, shearing machines, forges etc. are employed in these operations.

In addition to fabrication operations, the making of metal parts requires processes such as cleaning (to clean and prepare the part for subsequent operations), plating (to deposit a thin coating of one material on a part made of another material), or heating (to harden the material or to relieve stresses caused by fabrication).

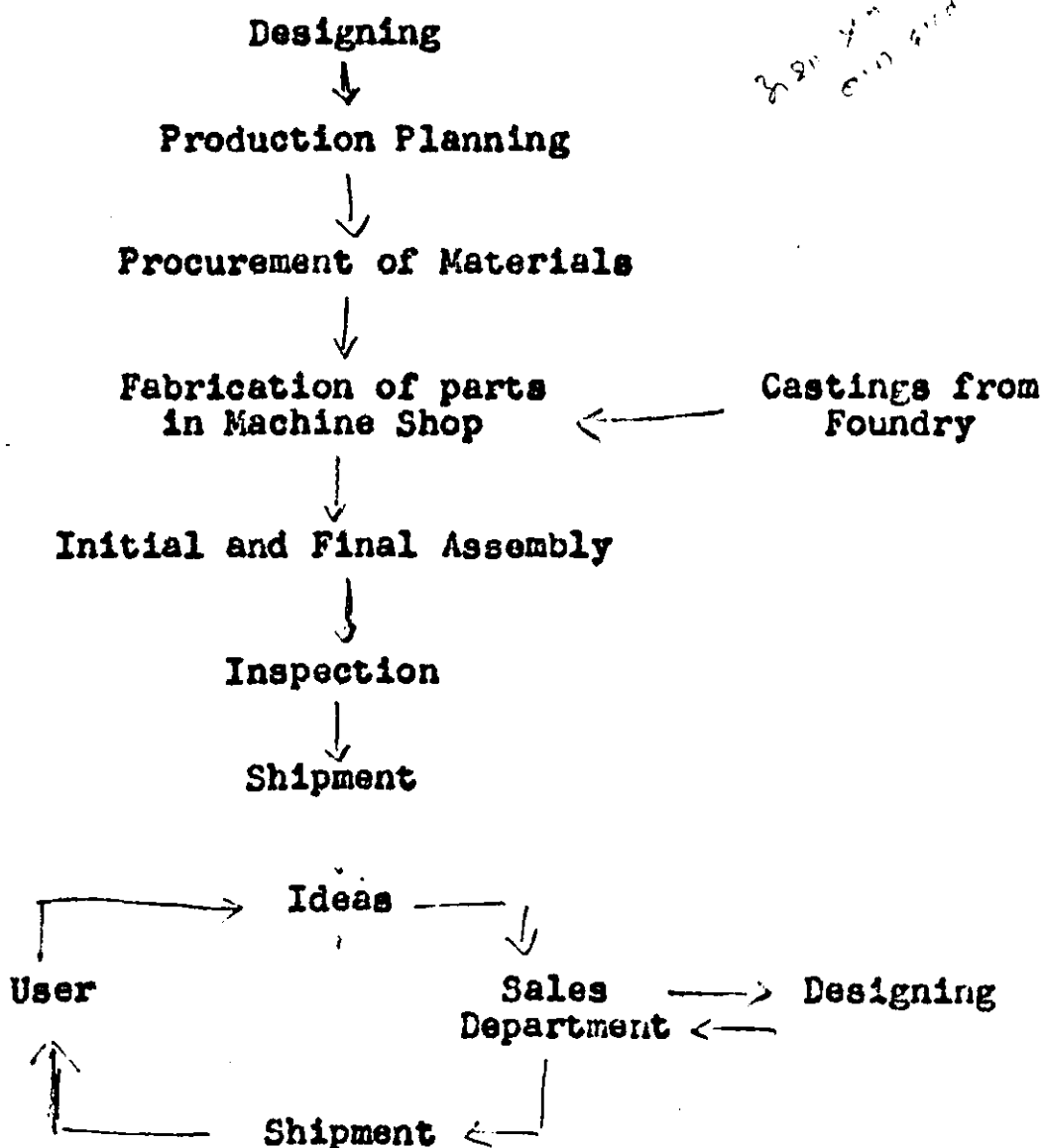
(c) Assembly

Once the parts are fabricated according to specifications in the machine shop, they are taken to the assembly shop for the next stage of operations, which consists of assembling the parts together in such a way as to produce the final product. The assembly of smaller parts or smaller sub-assemblies of larger products may require only workers at benches putting the components together with the aid of simple hand tools; such as spanners and hammers. Larger sub-assemblies may require special holding devices for supporting components, cranes for moving the assembly from one work station to the next and rivetting or welding equipment to bind parts together. Afterwards the assembled product is taken for inspection and testing, often inspection and testing

operations are inserted throughout the production whenever the cost of testing is deemed less than potential gain of finding defects at this stage rather than later.

In addition to these manufacturing operations, there are certain other phases, through which a product goes, from its idea on a blueprint to the stage of final shipment. A product requires careful designing, production planning, procurement of materials etc. These stages are shown in the following illustration.

The stages through which the product passes before its final shipment to the user



Equipment

Types

The Table 2.1 shows the inventory of machine tools installed in large and medium sized units in machine tool industry and the total metal working industries for the year 1963. It shows that lathes formed a major part of metal-working equipment in the machine tool firms. Grinders come next and milling and drilling machines follow afterwards. In the inventory for total metal-working industry, the second place goes to drilling machines and the third to grinding. This indicates the greater importance of precision work and finish in the machine tool building than in most other metal working industries. The greater use of metal cutting equipment than metal forming ones such as presses and shearing machinery may be noted in the machine tool industry. The use of metal forming equipment is comparatively greater in total metal working industries.

The typewise analysis of installed machinery in three major firms studied, given in Table 2.2 also confirms the pattern indicated by the data for the machine tool industry by the NCAER. There is a preponderant proportion of lathes, grinding and drilling machines. A sizeable proportion of milling machines is used. The proportion of metal forming machines, such as presses and hammers, is significant. Though

Table 2.1 : Machine Tools Installed in the Organized Sector of the Machine Tool Industry and Total Metal Working Industries in India in 1963

Type	Numbers			
	Machine Tool Industry	%	All Metal Working Industries	%
Boring	251	4	1,688	3
Broaching	18	-	177	-
Drilling	678	10	10,771	17
Gear-cutting	186	3	936	1
Grinding	1,516	22	9,494	15
Lathes (including Capstans and Turrets)	1,744	26	16,675	26
Milling	751	11	4,787	7
Planing	204	3	965	1
Sawing	269	4	2,929	5
Shaping (including Slotting)	284	4	2,385	4
Threading	64	1	749	1
Tapping	17	-	1,020	2
Presses	223	3	7,304	11
Shearing	77	1	1,162	2
Bending (other than rolls)	21	-	305	-
Polishing	75	1	1,568	2
Other metal working machine tools (NES)	387	6	2,062	3
Total	6,765	100	64,977	100

The dash (-) indicates the amount either zero or below 0.5.

Source: National Council of Applied Economic Research. Demand for Machine Tools, New Delhi: August 1965, p. 54.

Metal working industries given in the Table include Heavy and Light Mechanical Engineering Industries, Industrial Machinery, Tools and Machine Tools, Automobiles, Internal Combustion Engines, and Allied Industries; Electrical Engineering, Instruments, Steel and Aluminium Plants, Rolling Mills, Castings and Forgings.

Table 2.2 : Typewise Analysis of Installed Machines (Numbers) in Three Firms as in 1964

Type	Investa I	Per cent II	Praga III	Per cent IV	Mysore Kirloskar V	Per cent VI
Automatic	6	3	-	-	3	1
Boring	14	6	11	4	11	3
Broaching	1	-	-	-	3	1
Drilling	24	11	51	17	70	16
Gear-cutting	12	5	1	-	19	4
Grinding	58	25	57	19	90	21
Capstans and Turrets	15	7	34	11	42	10
Lathes	40	18	62	20	105	24
Milling	24	11	45	15	38	9
Planing	7	3	7	2	12	3
Sawing	13	6	8	3	6	1
Shaping	4	2	9	3	12	3
Slotting	1	-	1	-	2	-
Threading	1	-	1	-	3	1
Tapping	-	-	2	1	2	-
Presses	8	4	2	1	7	2
Hammers	-	-	6	2	1	-
Others (NES)	-	-	8	3	13	3
Total	228	100	305	100	439	100
Foundry Equipment (such as Cupola, Furnace, etc.)	10		22		81	
Material Handling Equipment (such as Cranes, Hoists, etc.)	8		N.A.		36	
Others (Inspection Machinery, measuring instruments, etc.)	32		N.A.		41	

The dash (-) in the Columns II, IV and VI shows the figure below 0.5 or zero.

Source : Data from the firms.

the proportion of different types used is different for the three firms, the importance of certain types such as lathes, drilling, grinding, and milling machines is seen.

Though a few automatic and special purpose machines are installed, the preference is still towards the universal types of machine tools, which, with the aid of special jigs and fixtures can be used for multiple operations. With production characterized by product diversification and comparatively low level of output of each of technologically dissimilar products, the economies of mass production are not fully utilized as the method of batch quantity production is preferred to the mass production techniques.

Import Content of the Machinery Installed

A part of the equipment installed in machine tool factories is imported, as not all the types are manufactured in India. Moreover, the firms try to get an imported machine for the sake of its better quality and precision. The machines are imported mainly from industrially advanced countries such as U.K., U.S.A., West Germany, Eastern European Countries and U.S.S.R., etc.

The Table 2.3 shows how the relative proportions of imported machines from these countries have changed over a period of time. The data are for three machine tool firms established during the Second World War. The machines bought during the first decade of their existence are mainly from U.K. and U.S.A. During the Second World War, machines from U.K. were mainly imported. Only special machines, not available

Table 2.3 : Import Content of Installed Machinery in Three Firms - Countrywise Analysis (in Numbers)

Country	Investa		Praga		Mysore Kirloskar	
	Upto 1954	1955-1964	Upto 1954	1955-1964	Upto 1954	1955-1964
U. K.	28	2	60	18	66	34
U. S. A.	17	19	33	30	30	27
West Germany	-	28	-	7	2	19
Other Western European Countries	-	8	2	2	5	6
Czechoslovakia	-	23	8	6	1	26
Poland	-	1	-	54	-	3
Hungary	-	4	-	-	-	-
East Germany	-	20	-	-	-	3
Other Eastern European Countries	-	1	-	1	-	2
U. S. S. R.	-	8	-	-	-	-
Japan	-	1	-	-	-	-
Total	45	95	103	118	104	120

Source : Data from the firms.

in U.K. such as Fellow's Gear Shaper, were bought from United States. Immediately after the war also, the firms bought machines from U.K. and U.S.A. which dumped their surplus war production in India.

After 1954-55, the firms undertook the plans for massive expansion, and entered into various collaboration agreements with many other countries. From 1954 onwards, the proportion of machines imported from the U.K. and U.S.A. has declined. A sizeable portion of machines were bought from West Germany, and Eastern European Countries. The convenience of rupee payment agreements was partly responsible for the firms importing machines from these countries. In recent years, a sizeable number of indigenous machine tools are installed. This is due to the greater availability of different types and sizes within the country and total ban on the import of more general types of machine tools.

Agewise Distribution of Machinery Installed

The Table 2.4 shows the agewise distribution of installed machinery in three firms. The firms still operate with a part of equipment which is old, though they have either made large investments in new plant and machinery recently, or have rebuilt the existing plants, so as to expand the plant capacity after 1955. Investa still operates with capstans and turrets, which are over 15 years old. About 40 per cent of Praga's lathes, grinding and milling machines are over 15 years old. Mysore Kirloskar has installed many advanced types

Table 2.4 : Age Distribution of Installed Machinery in Three Firms (Numbers)

	1960-64			1955-59			1950-54			1945-49			Upto 1944		
	Under 5 years			5 - 10 years			10 - 15 years			15 - 20 years			Over 20 years		
	Investa	Praga	Mysore Kirloskar	Investa	Praga	Mysore Kirloskar	Investa	Praga	Mysore Kirloskar	Investa	Praga	Mysore Kirloskar	Investa	Praga	Mysore Kirloskar
Automatic	4	-	3	2	-	-	-	-	-	-	-	-	-	-	-
Boring	10	6	3	-	1	-	-	1	4	2	3	2	-	-	2
Broaching	-	-	2	1	-	-	-	-	-	-	-	1	-	-	-
Drilling	18	16	25	2	18	19	1	4	16	-	10	7	3	3	3
Gear-cutting	6	1	8	3	-	8	1	-	1	1	-	1	-	-	1
Grinding	42	28	51	5	4	11	2	-	10	9	22	10	-	3	8
Capstans and Turrets	4	24	20	-	1	10	-	1	3	11	7	6	-	1	3
Lathes	30	29	53	4	5	34	1	1	14	3	24	4	2	3	-
Milling	14	19	18	1	4	9	1	3	2	6	15	5	2	4	4
Planing	7	4	6	-	-	2	-	1	1	-	2	3	-	-	-
Sawing	7	1	2	1	2	1	-	2	2	1	3	1	4	-	-
Shaping	4	2	4	-	1	3	-	-	1	-	5	2	-	1	2
Slotting	-	-	1	-	1	-	-	-	-	-	-	-	-	1	1
Threading	1	-	1	-	-	1	-	-	-	-	1	1	-	-	-
Tapping	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-
Presses	8	-	4	-	-	1	-	-	1	-	2	1	-	-	-
Hammers	-	-	1	-	1	-	-	3	-	-	2	-	-	-	-
Others (N.E.S.)	-	4	7	-	-	6	-	2	-	-	2	-	-	-	-
Total (Machine Tools)	155	136	209	19	38	106	6	18	55	33	98	44	15	15	24
Foundry Equipment (such as Cupola, Furnace, etc.)	7	3	38	1	3	11	1	3	17	1	8	12	-	-	5
Material Handling Equipment (such as cranes, hoists, etc.)	6	N.A.	26	-	N.A.	6	-	N.A.	2	-	N.A.	-	2	N.A.	2
Others (Inspection machinery, measuring instruments, etc.)	28	N.A.	24	1	N.A.	5	1	N.A.	12	-	N.A.	11	2	N.A.	-

Source : Data from the firms.

of machines in recent years but about 40 per cent of their machinery is over 10 years old.

In the factories studied, common types of cone-pulley lathes, drilling machines, single and double ended grinders were to be found. These are mostly rebuilt machines, bought secondhand and installed since the Second World War. These small aging units continue to be used with occasional re-conditioning and overhauls. Their survival is attributable mainly to the price of new equipment, which is high compared with the depreciated investment in old equipment. Thus factories are not in a hurry to replace the old equipment with its modern counterpart.

Another factor responsible for the existence of older machines along with the equipment of modern design is the relatively low wage rates in India. For precision jobs, the costly high precision machinery of modern designs has to be installed, similarly, heavy duty machinery is needed for jobs of bigger sizes, but the cost involved in using such equipment is very high in India compared to the cost of labour needed to man these machines. Hence low cost older machine tools are used wherever possible, even if they are capable of turning out a much smaller number of jobs within a specified time period than a high cost machine of improved design would do. The case is different in industrially advanced countries where the wage rates are

considerably higher and the emphasis is to save the labour cost.¹

This continued dependence on labour intensive techniques along with the use of capital intensive methods is seen through all the manufacturing operations. In a foundry attached to a machine tool factory both types of cupola existed; one to be charged by hand with no temperature or fuel control and also the electrically charged one with latest devices of temperature and fuel control. A machine shop has automatic and semi-automatic lathes along with cone-pulley lathes. The materials handling methods also tend to have both modern and traditional aspects. All types and gradations of conveying, feeding and unloading devices from cranes to hand-lifting are to be found in the shops.

1 If the value of machinery is expressed as a monthly rental value and if the ratio of this monthly rental value to the monthly remuneration of the operator is computed, then a measure of the relative importance of machinery is obtained. In the following Table, are given some calculations made by Morris J. Solomon, which show that this ratio is very different in India, as compared to that in United States.

Table 2.5 : Monthly Costs of a Specific Machine in India and the United States

	Monthly rental value *	Monthly remuneration of operator	Ratio of rental value to operator remuneration
India	Rs. 2,200	Rs. 150	14.7
U.S.A.	\$ 465	\$ 300	1.6

* Depreciation, interest and maintenance.

Source: Morris J. Solomon. Better Plant Utilisation in India-- A Blue-print for Action. Statistical Publishing Society, Calcutta, and Asia Publishing House, Bombay: 1963, p. 4.

The greater use of labour intensive methods by Indian machine tool manufacturers as compared to those in the industrially advanced countries is also revealed by the comparison of ratios of the machine shop labour hours to the assembly labour hours. In countries such as U.S.A. and West Germany, the machine tool builders reduce the labour cost in assembly by giving most of the finish to components in the machine shop either through changes in design of parts, or improved production techniques. The ratio of manufacturing time or machine hours to assembly time or hand labour hours is of the order of 2.5:1 and 3:1 in United States and West Germany respectively.¹ In Indian machine tool factories studied, this proportion ranged from 10:7 to 1:1 in different factories.

Materials

The raw materials required for the production of machine tools fall under the following broad categories:

- (a) Iron and steel metal--castings, plates, sheets, bars, wires etc., and ferro alloys.
- (b) Non-ferrous metals and semi-manufactures and alloys.
- (c) Bolts, nuts, screws, and ball bearings.
- (d) Chemicals.
- (e) Electrical motors, wires etc.
- (f) Ancillaries such as clutches, chucks, etc.
- (g) Fuels and lubricants and electricity.

¹ National Productivity Council. Report of the Indian Productivity Team, Machine Tool Industry in West Germany, U.S.A. and Japan. New Delhi: 1963, p. 29.

Grey iron castings chemically include a large number of metals, covering a wide range, in composition with carbon varying from 2 to 4 per cent and silicon from 0.5 to 3 per cent with small amounts of Ni, Cr, Mo and Cu; frequently added. This is the most commonly used type because of its ready availability, moderate cost and suitability for both simple and complex castings.

Good quality castings are essential, if strength, stability and machineability are to be achieved. Blow holes and local hard spots can play havoc with the machined faces and bores. Because of the under-developed nature of the foundry industry in India, the machine tool builder prefers to have his own foundry attached. The ageing of castings is very important and while there are artificial methods of doing this in a short time, a casting left lying to rust in the yard for six months or more after rough machining, is generally accepted as the best proposition. The demands of the production, however, frequently preclude the possibility of such leisurely treatment.

Compared with the requirement of grey iron castings, the steel castings are not in such general use, but the demand for them is increasing for larger structures where particular tensile strength is required. The largest demand for steel castings for the industry is from HMT. In future the demand is likely to increase substantially because of the programmes of building heavy machine tools at the Ranchi Plant and from private machine tool builders undertaking the manufacture of heavy items.

Mild steel refers to a variety of steel which usually contains not more than 0.3 per cent carbon and around 0.5 per cent manganese, 0.2 per cent silicon and 0.05 per cent each of phosphorus and sulphur. It can be bent and twisted with much less force than other sorts of steels. The molten mild steel is poured into moulds and converted into ingots, sheets or plates or rolled sections.

Alloy steels owe their enhanced properties to the presence of one or more special elements or to the presence of larger proportions of elements such as manganese and silicon than are ordinarily present in mild steel. The more common alloy steels used are stainless steel, and heat resisting steels, which have a small percentage of chromium and nickel in their composition.

High speed steels and tool steels contain large amounts of carbide forming elements which serve to furnish wear resisting carbides and to increase resistance to softening at elevated temperatures. These are generally used for the manufacture of planing and milling cutters, twist drills etc.

Non-ferrous materials that are normally consumed are copper tubes and other copper materials, brass tubes and other brass materials, bronze, aluminium tubes, tin, gunmetal etc.

Fuel and lubricants include coal, coal gas, coke, firewood, charcoal for foundry purposes, motor spirit, and other fuel oils, lubricating oils, industrial and power alcohol etc.

The latest available figures for total consumption of major inputs by Large Scale Machine Tool Industry in India, are for the year 1963 from Annual Survey of Industries 1963, Vol. VIII, as given in Table 2.6. The reference to this Table indicates the relative importance of each input by size in the total consumption. By far the biggest consumption is of iron and steel materials. Of this component, iron and steel castings are of major importance, according to the quantity. Various types of steels are next in importance. The share of components and accessories in the 1963 consumption was 23 per cent. Fuels, lubricants etc. formed about 5 per cent of total materials consumed.

Availability of Materials

The position of availability of an important input, foundry grade pig iron, continued to be difficult till 1965-66. The manufacturers were not getting pig iron in right grades or in adequate quantities.¹

Since 1966 onwards, however, the situation seems to have improved. The improvement in situation is partly due to the attempts by the Government to improve the quality and

1 (i) Indian Machine Tool Manufacturers' Association, Bombay, Annual Reports, 1962-63, 1963-64, 1965-66.

(ii) Government of India, Planning Group on Machinery Industries, Fourth Plan, Report of the Working Group on Machine Tools (Group VI, July 1964), p. 44.

**Table 2.6 : Materials Consumed during 1963 by Machine Tool
Factories a/**

Item	Rs. in thousands	Per cent to the total
Pig iron	2,635	3.1
Scrap	1,917	2.3
Castings	13,294	15.8
Forgings	2,369	2.8
Plates, sheets and strips	807	1.0
Angles, channels, shapes and sections	305	0.4
Girders, beams and joists	28	-
Bars and rods	2,223	2.6
Pipes and tubes	987	1.2
High speed steel	332	0.4
Special steel	5,077	6.0
Steel shafts	114	0.1
Wires	14	-
Ferro-alloys	773	0.9
<u>Total iron and steel material</u>	<u>30,875</u>	<u>36.8</u>
Non-ferrous metals and alloys	3,456	4.1
Refractories	30	-
Ball and roller bearings	2,488	3.0
Nuts, bolts, rivets, washers, nails, etc.	1,082	1.3
Electric motors	5,032	6.0
Electric wires and cables	23	-
Timber, other than for packing	209	0.2
Components and accessories	19,448	23.1
Others	2,554	3.0
Chemicals	2,942	3.5
Packing material	2,330	2.8
Consumable stores	7,503	8.9
Materials consumed for repairs etc.	1,341	1.6
<u>Total raw materials</u>	<u>79,527</u>	<u>94.7</u>
Fuels, lubricants, electricity, etc.	4,445	5.3
<u>Total</u>	<u>83,972</u>	<u>100.0</u>

a/ 47 factories.

The dash (-) indicates the amount less than 0.05.

Source: Government of India, Central Statistical Organisation, Department of Statistics, Cabinet Secretariat. Annual Survey of Industries 1963, Vol. VIII, Calcutta: pp. 91, 92, 94.

availability of pig iron and partly to the lessening of demand of pig iron castings from the manufacturers themselves because of the present recession.¹

Other materials, such as plate, sheets, bars, chemicals, electrical motors, fuels and lubricants are indigenously available in sufficient quantities.² Coke, however, is high in ash content, difficult for the manufacture of good castings.³

All of the various types of steel required by the machine tool manufacturers were imported upto 1965-66. Major difficulty in the supply of steel indigenously, was the lack of standardization in the types of steel required. The Indian Standards Institution reduced the requirement to broadly three types, and Hindustan Steel Limited, Alloy Steel Division, Durgapur had undertaken by 1966-67 to supply the manufacturers steel on the basis of types and sizes standardized.⁴

The requirement for ball and roller bearings for the machine tool industry is of a specialized nature all the world over. Bearing manufacturers in foreign countries make special

1 Interview with the Secretary, Indian Machine Tools Manufacturers' Association, 23rd April 1967.

2 Ibid.

3 Report of the Working Group on Machine Tools, op.cit., p. 44.

4 In 1966-67 there was not enough demand from the machine tool manufacturers for the quantity of steel offered by HSL. This was probably due to recession. Interview with the Secretary, IMTAA, Bombay, 23rd April, 1967.

efforts in selecting bearings, conforming to high standards of accuracy and mark them as such for supply to machine tool manufacturers. In India, in the absence of such a practice, bearings manufactured for general consumption are not accurate enough for the machine tool for it to give accurate performances. Thus greater part of ball and roller bearings are imported.¹

The requirements of clutches and electrical controls, except some standard starters are mostly met by imports. Also are imported ancillary components such as dividing heads, precision chucks, pneumatic chucks, electromagnetic chucks, quick change drill chucks. A few of the ancillary units in the industrial estates, set up by HMT and Mysore Kirloskar, have undertaken the manufacture of some of these items. The Working Group recommends that these items should be wholly manufactured within the country.² Similarly, there is a need for creating capacity for design and manufacture of tooling equipment for capstans and turrets, and for automatics. In 1964-65, all the tooling equipment for these is imported.³

Compared to the situation in 1963-64, the position regarding the availability of imported raw materials, components, and spare parts for the machine tool industry has improved a good deal during the last two or three years.⁴ On 21st June

1 Report of the Working Group on Machine Tools, op.cit.,p.44.

2 Ibid, p. 45.

3 Ibid, p. 45.

4 IMTMA, Bombay, Annual Report, 1966-67.

1966, the Government of India announced a liberalized scheme for import of raw materials, components and spare parts in order to secure higher levels of production. The scheme was applied to 59 specific industries (of which machine tool industry is one) which were treated on a priority basis. The requirements for production upto full capacity for six months was to be met, and the licences were to be granted to cover the full requirements of the priority industries not only for the current year but on a continuing basis afterwards.¹ The complaints of the manufacturers are voiced, not so much against the non-availability of requirements which are to be imported, but against the cumbersome administrative procedures which are to be gone through before the licence is granted.

The descriptive account of the equipment and materials required in the machine tool industry presented in the foregoing pages is followed up in the next chapter by computing input and capital coefficients for selected firms and for the whole of the industry, so as to understand the relationships between various types of inputs and the output, in machine tool manufacturing.

¹ Federation of Indian Chambers of Commerce and Industry, Procedures for Industrial Licensing, New Delhi: 1966, p. 16.

CHAPTER 3INPUT INVENTORY AND CAPITAL COEFFICIENTS IN
THE MACHINE TOOL INDUSTRY

The object of this chapter is to analyse the input and capital structure and also to show the inter-firm variations in input and capital costs among machine tool firms. Proportional relationships between input and output will aid to compute the requirements of raw materials for any future period, if the final demand for machine tools is given. Alternatively, if the prospective material availability is known, possible production from the domestic resources at some future date can be worked out. Similarly, the relationships between capital goods and output will aid to forecast the capital needs for the future period, given the machine tool demand.

Some Conceptual and Practical Problems in
Estimating Input and Capital Coefficients

Two problem areas in estimating input and capital coefficients may be pointed out. They are: (i) the industry problem, and (ii) the output and capacity problem.

The Industry Problem

There is a core group of establishments, which are persistently classified in but one industry and that, even though the number of such plants is small relative to all

the plants which make an industry's products, these core plants produce a large and stable share, and may be thought of as 'typical' of the industry. Nonetheless, the methods of industrial classification result in industrial composition, which includes many plants with diverse characteristics. Their sizes are different, products are highly diversified and different plants follow different technologies.

The fact that many manufacturing industries are composed of plants which are so different is so important in the derivation and interpretation of input and capital coefficients. The technological character of the industry coefficients must be understood in a very broad sense, no single technology dictating the values for the coefficients. Hence input and capital coefficients for an entire industry should represent properly weighted averages of the input and capital requirements of all the various elements of that industry, and even then their reliability may be doubtful. For with all the things which may influence input and capital coefficients - location, product, size, degree of integration, market conditions, etc., it is very easily possible that very accurate information on inputs consumed, capital stocks and rates of output would display little evidence of a marked central tendency among the plants in the industry. It should be expected that large differences would appear in input and capital coefficients of various plants in the same industry. Choosing these coefficients which best

represent the industry is an extraordinarily difficult averaging process.

Thus instead of commenting on the 'best representative' coefficient, the input and capital coefficients for five major machine tool firms, which are not far dissimilar in products, technology and size (with the exception of HMT), are presented along with the input and capital coefficients based on the All India data for machine tool industry, given in the volumes of the Annual Survey of Industries.

Output and Capacity Problem

Flow and stock coefficients require an output denominator for their analysis. The denominator is generally taken as the gross output of the industry.

The problem arises, when gross output is used for computing capital coefficients. Basically, the measurement of the capital coefficient is to provide a means for estimating induced investment. This requires that the coefficients be ratios of the stocks of various capital items to the 'capacity' output rate of the given industry. Capacity used in this sense, implies the rate of output of an industry beyond which additions to these stocks will tend to be made. This being the case, the output problem is further complicated by the necessity of estimating the capacity to which capital stocks are appropriate. In general, it may be possible to measure the capacity of a plant, if

all this implies, is that one can ascertain the rate of output which is 'best' for the facilities which are installed in the plant at some point of time.¹ That such a measure will be useful in dating the time at which investment takes place seems less obvious. If it does not, the usefulness of the capital coefficients for anything other than a description of the past may be severely restricted.

Apart from the problems of determining the 'optimum' or 'best' rate of capacity output, difficulties may be mentioned in getting the capacity data. Many firms do not give the necessary data and even those which may be available, cannot be used for further treatment, because of inconsistency in different estimates.

Capital Coefficients from Accounting Data

Use of accounting data adds another element to the industry problem, since the firm, the usual accounting unit, may have establishments in different industries, or may be producing in the same plant, other items, in addition to the products considered. Thus, in addition to differences which may exist among establishments in the same industry, there is an added possibility of inter-industry diversity within and among the firms. Furthermore, the use of balance

¹ These aspects of optimum capacity and unbalanced nature of capital equipment are discussed in Chapter 8.

sheet data to obtain the value of plant and equipment requires that a choice be made between the depreciated and undepreciated values, and raises questions concerning the character of either valuation, since the property was acquired at different times. Similarly sales values from income accounts pose price problems if capital-output coefficients at different points in time are to be compared. It is the price-change corrections with respect to the capital asset values, however, which present the more difficult problem. The problem of unbalanced use of facilities would not be involved in the case of accounting data if the firm is presumed to be operated at capacity. This is not necessarily so. There may be no output of the usual product-mix of a firm that will completely utilize all the existing facilities. If capital coefficients for this mix is desired, some deletion of capital items becomes necessary. The averaging problem also exists if capital coefficients for individual firms turn out to be widely dispersed.

Accounting data makes it necessary that capital coefficients be stated in money terms. Apart from the overall capital coefficient, separate coefficients for each type of capital facility can also be computed for individual firms and the industry. From these two coefficients, the capital requirements of individual plants and the industry can be stated in somewhat different ways.

It is not difficult to visualize an approximately

ideal set of accounting information on assets and capacity output values. Such an ideal can be realized, if the firms could be induced to provide an analyst with the detailed data of its plant and equipment facilities : (i) classified by the industry which produces them, (ii) deleted of any items or facilities not required for a stipulated product-mix which will use all facilities to capacity, and (iii) valued at the cost of replacing such facilities with the best current ones. Thus, given the current sales values of the capacity output, the establishment coefficients could be computed for the given point of time. Comparisons with similar data for another time period, would, however, still require price adjustments, if the sales prices of products and of capital items changed disproportionately.

The separate coefficients of this sort for each capital facility, deleted of any items or facilities not required for the optimum product-mix are computed, based on the results of the analysis of optimum capacity and imbalance of capital equipment of two machine tool firms.¹ The capital facilities, however, are not valued at the cost of replacing them with the best current ones. The estimation of coefficients involves rather bold assumptions regarding the value of balanced equipment, which are discussed in the next section, 'Methodology and Assumptions', of this chapter.

¹ Chapter 8, for the analysis of optimum capacity and imbalance capital equipment of two firms.

Methodology and Assumptions

By input coefficients (or flow coefficients) we mean the amount of inputs required from each industry to produce one unit of output of a given industry. The unit is taken to be a rupee of output. Thus,

$$\text{Input coefficient} = \frac{\text{Amount of input (in money terms) consumed during the calendar year}}{\text{Output (in money terms) during the same year}}$$

Inventory coefficient is defined as 'an estimate of the total stocks of an input which must be held in the economy per unit of unit'.¹

In the numerator, stocks at the beginning of the accounting year are considered, which are supposed to be dependent upon the input requirements of the firm producing the output at the end of the accounting year, which is a denominator. Thus,

$$\text{Inventory coefficient} = \frac{\text{Stocks of input (in money terms) at the beginning of the accounting year}}{\text{Output (in money terms) at the end of the accounting year}}$$

The capital coefficient is usually defined "as the quantity of capital required per unit of capacity of an industry."²

¹ Robert N. Grosse, "The Structure of Capital," Studies in the Structure of the American Economy, Leontief et al. Oxford University Press, New York, 1953, p. 205.

² Ibid, p. 185.

The difficulties of assessing capacity for a multi-product firm are discussed in this chapter and in Chapter 9. The capacity output for all the years from 1956 through 1964 were not available. So the output figures are used in the denominator with the heroic assumption that firms operated at full capacity through all these years. That this assumption is absurd, is seen from the results of the statistical analysis given in the following pages. The capital coefficients based on output data and those based on estimated capacity data for the four firms for the year 1964 are also presented afterwards, to indicate the difference between the two estimates. In the numerator gross values for fixed capital items are used along with the gross values of output in the denominator. Depreciation accounting methods employed by the firms varied widely, so as to make statistical results based on net values not comparable. An installed machine was probably used at approximately constant levels of output for a period for beyond the accounting life of the machine, measured by normal depreciation, until it is eventually discarded or sold for scrap. Furthermore, the numerous special depreciation allowances to encourage industrialization, which are included under depreciation in the profit and loss accounts, distort any relationship between the depreciation set aside and the life of the capital goods. Hence only gross values are considered.

The output data for capital coefficients were computed from the profit and loss statements in the following manner.

Output = Gross sales plus closing stock minus opening stock, (for finished goods and work in process)

Thus,

$$\text{Capital coefficient} = \frac{\text{Gross fixed assets (in money terms) at the end of the accounting year}}{\text{Gross output (in money terms) during the same year}}$$

The Industries Classification of the Annual Survey of Industries (ASI) was used for grouping the data on raw materials and fuel in the tables for input and inventory coefficients. The fixed assets are grouped in the following categories: (1) Land, (2) Buildings, (3) Plant and Machinery, (4) Electrical installations, (5) Laboratory equipment etc., (6) Furniture and fixtures, and (7) Vehicles.

The data were obtained from five firms which accounted for about 65 per cent of the total production of graded machine tools in India.

To deflate the series of gross fixed assets, the index number ^s prepared by the D.G.S. & D. were used. These index numbers are based on government contract prices, hence, it is assumed that the difference between prices to the government and those in the open market is not significant. Considering that the proportion of imported items was substantial in the fixed assets of the firms, the D.G.S. & D.

indices were found to be especially suitable, as they are combined for both indigenous and imported items. The gross capital figures were deflated in terms of the prices of a single year (1956-57). So that a comparison could be made over time. The gross fixed asset figures for any year after the first were derived by deflating the annual additions to gross fixed assets by relevant capital goods price index, and adding the sum of the deflated annual additions to the initial gross asset figures of 1955-56, for various groups.

The D.G.S. & D. price indices for machine tools, cement and iron and steel products, the electricals, automobiles, are used to deflate the values of plant and machinery, buildings, electrical installations and vehicles respectively.

Weights given to cement and iron and steel products in the combined index for buildings, are 3 and 1 respectively.

The output figures were deflated directly by the relevant price of output index. The price indices for output were calculated in the following manner. The values of unit output of the firms for a given year were calculated by dividing the value of the output for the firm in that year by the physical quantity of output (by numbers) in the same year. These average unit values were converted into index number series with 1956-57 = 100 to get a deflating

series. These series are combined to form index number series for the total output of four firms, by weighting each separate price index in a given year, with weights equivalent to proportion of the firm's output in total output in that year. For the index numbers in any two years to be comparable, it was assumed that the product-mix in each of the years was relatively stable. This was a reasonable assumption except for HMT.

The capital coefficients for various facilities in the machine shops of two firms were computed from the data given in Tables 8.5 and 8.6 of the Chapter 8. The Linear Programming Model, in addition to indicating the optimum capacity output, helped to obtain indices of capacity utilization of various facilities for that output. The index for capacity utilisation of a particular facility multiplied by the book value of the facility, is assumed to give approximate gross value of utilised facility. The logic underlying this assumption is simple. A machine shop has ten lathes costing Rs. 10,000 each (total gross value Rs. 1 lakh) and if only half the capacity is utilized, it is tantamount to saying that only five lathes were used, the gross value of utilised facility being Rs. 50,000.

Empirical Results

The input coefficients given in Table 3.1 show that these are different for different firms, for the same item.¹

¹ All the relevant tables are attached at the end of this chapter.

They are also different for the same firm for each of the two years considered. The input coefficient of iron and steel metal is as high as 0.0887 for Mysore Kirloskar in 1962 and as low as 0.0220 for HMT in the same year. Wide variations are also seen in the input coefficients for ferro-alloys, castings and forgings, iron and steel plates. For the iron and steel structurals as a whole, variations are not wide, but variations for individual items such as plates, sheets, strips, angles, shapes, bars and rods etc. are seen in the case of all the firms. The consumption of special steels per rupee of output differs for different firms. HMT uses high proportion of special steels as compared to others.

The coefficients of non-ferrous materials, hardware, ball bearings, electric motors seem to be varying widely among the firms.

The coefficients for All India are markedly different from those of other firms, but are rather similar to those of HMT, which accounts for more than half the All India total output. This fact may be reason for the All India coefficients being in line with those of HMT.

In effect, there is hardly pattern to the input-coefficients of the various firms and those based on All India data. As the technology followed in the firms is more or less the same, the reason may be found in the nature of the products manufactured. HMT manufactures a high proportion

of heavy machine tools and precision machinery, while Investa manufactured general types of simple machine tools. This may account for the high steel coefficient for HMT and low steel coefficient for Investa. The methods of pricing the products differ for different firms and contribution of the products of one firm is different from that of the other. This has also affected the values of the coefficients. Perhaps physical coefficients stating the quantities of inputs in physical terms, per, say, one kilogram weight of machine tool, may avoid the difficulties caused by having to state the coefficients in monetary terms, but the available data would not allow to compute physical coefficients.

The coefficients for fuel and power (Table 3.1) also vary widely. Here the technology followed has affected the coefficients for coal. HMT with its electrically operated foundry has less coal consumption per rupee of output than for other firms.

The behaviour of inventory coefficients is extremely erratic. The inventories per rupee of output for most of the items in the case of Mysore Kirloskar are very small when compared to those in the case of HMT, which are by far the largest. Very high inventory coefficients of iron and steel structurals for Praga may be noted.

A reason for wide variations of coefficients is the differing nature of inventory policies of individual firms,

or more correctly, the absence of any clear inventory policies of the firms. There also seemed to be a general tendency to overstock the items which were imported such as ferro-alloys, steels, components, despite the locking of capital due to the fear of uncertain import policies of the Government.

The Table 3.3 gives capital coefficients based on the data for four firms. The coefficients for the total fixed assets go on decreasing except in 1959-60 and 1961-62, when large additions to the assets of two of the companies took place. The decreasing trend is also seen in the coefficients for plant and machinery (except in 1959-60) and buildings (except in 1959-60 and 1961-62). Unusually large capital coefficient for plant and machinery in 1956 is due to HMT's having very low production during that year. The coefficients for All India, based on the data from Annual Survey of Industries are much less in magnitude than those for the four firms together, as shown below.¹

Year	Four Firms		All India	
	Plant and machinery	Total fixed assets	Plant and machinery	Total fixed assets
1962-63	0.6826	1.2353	0.4617	0.9512
1963-64	0.6485	1.1495	0.4224	0.8401

¹ Annual Survey of Industries 1962 and 1963, op.cit.

The firms considered by the Annual Survey of Industries (which include the four firms considered in this chapter) employ a much less proportion of fixed capital per rupee of output than the four firms studied.

The capital coefficients given in Table 3.4 adjusted for price changes (using the price indices shown in Tables 3.6 and 3.7) also indicate a decreasing trend, except in a few years when large additions to fixed assets took place. The same is the case with coefficients for plant and machinery and total fixed assets for individual firms as shown in Table 3.5.

It would be, however, incorrect to conclude from the data that the industry is becoming less capital intensive. The coefficients do not take into consideration the unutilized capacity. The trend can merely point out that the firms are being operated more efficiently and the index of capacity utilization has gone up. This observation was verified by interviews with factory officials who said that the extent of capacity utilization was improving over years. Exact details regarding capacities of the plants for all the previous years was not available. However, coefficients based on capacity output for the year 1963-64 are considerably less in magnitude than those based on actual output. The variations among the coefficients are also minimised when capacity output is considered, as can be seen from the following figures.

	Coefficients based on		Coefficients based on	
	Capacity output	Actual output	Capacity output	Actual output
	Plant and machinery		Total fixed assets	
Mysore Kirloskar	0.3812	0.5445	0.5444	0.7778
Investa	0.7946	2.6487	0.9734	3.2448
Praga	0.6202	1.5505	1.0888	2.2722
HMT	0.7153	0.8415	1.4406	1.6947

In Table 3.8 are given capital coefficients for two firms for various facilities in the machine shops, based on the optimum capacity production. The requirements for all the facilities or for individual facilities per rupee of output are different in the case of two firms. In the case of Firm A, the major requirements per rupee of output are planing machines, horizontal boring machines and capstan lathes. In the case of Firm B, the major requirements per rupee of output were these of planing machines, horizontal boring machines and capstan lathes. In Firm B planing, vertical boring and horizontal boring (in the order stated) were required. The nature of the products and slightly different production processes followed in their manufacture, account for the differences.

Considering the flow and stock coefficients, no single pattern in the behaviour of coefficients for all the firms

is seen. The coefficients of each individual firm are different from those of the other because of reasons of different product-mix, different production processes, differing rates of capacity utilization etc. Such disparities in the coefficients makes the averaging process very difficult and restricts the usefulness of coefficients for predictive purposes.

A Note on Cost Structure

Like other companies, all over the world, the machine tool firms regard their cost data as confidential and hesitate to give it to outsiders. However, the data from the four firms was made available, which might give broad indications regarding the relative proportions of the major components of costs.

The Table 3.9 shows the costs of major items per rupee of output. The data refer to four machine tool firms, which are arranged according to the size of their total fixed assets, which ranges from Rs. 5 crores to Rs. 50 lakhs. The data refer to the second half of the year 1964.

In the case of Firm A and Firm B, the raw materials cost per rupee of output was much greater than that for Firm C and Firm D. This was because Firm A and Firm B required greater quantities of costly materials such as special steels and imported components.

Both Firm A and Firm B employed greater number of direct production workers, especially highly skilled and

skilled workers, than the other two firms. This was reflected in higher direct labour cost per rupee of output for Firm A and Firm B. On the other hand the higher indirect labour cost per rupee of output for Firms C and D than the first two firms, showed greater use of indirect workers and less mechanization in production processes such as material handling.

The cost of depreciation per rupee of output was almost the same for all firms, the proportions being somewhat higher for Firm A and Firm D than for the other two. This was because of Firm A and Firm D having installed costly new machinery since 1962.

The administration and office overheads include such diverse items as printing and stationery, rent, rates and taxes, travelling, advertisement etc., but exclude selling agent's commission. These overhead costs were higher in the case of Firm C and Firm D, which utilized only 30 to 40 per cent of their capacity during the period to which the data relate. Very high proportion of interest in the case of Firm D is noteworthy, the expansion of which since 1962 was mostly financed through borrowed funds.

No data were available to compare costs over the years. It was suggested by the officials of the companies that the costs of raw materials, labour and overheads have gone up over years in absolute amounts, because of increase in prices and wage rates, and increasing complexity of

manufacture leading to increased cost of administration, but how these components have behaved relatively could be decided only if exact data were available.

The data would suggest that the size of the firm might affect the profitability of operations. There are various reasons to doubt such a conclusion. The number of firms studied here, is too small to give any meaningful indication. The utilisation of capacity is different for different firms. The high proportion of overhead costs for Firm C and Firm D is more due to the under-utilization of capacity than to any diseconomies of relatively small scale operation.

Having analysed the input and capital requirements of machine tool firms in the preceding pages, the focus of the discussion is turned to the financial performance of some of the machine tool firms, which forms the subject matter of the next chapter.

Table 3.1 : Input Coefficients

			(1) Materials									
Group Code No.	Group in A.S.I. Classification	Name of Input	I Mysore Kirloskar		II Investa		III Praga		IV H.M.T.		All India	
			1962	1963	1962	1963	1962	1963	1962	1963	1962	1963
341-1	Iron and steel metal		0.0887	0.0661	0.0466	0.0422	0.0237 ^{a/}	0.0258 ^{a/}	0.0220	0.0239	0.0242	0.0278
		Pig Iron	0.0657	0.0502	0.0278	0.0219	0.0228	0.0227	0.0141	0.0142	0.0154	0.0161
		Iron and steel scrap	0.0230	0.0159	0.0188	0.0203	0.009	0.0031	0.0079	0.0097	0.0088	0.0117
341-2	Ferro-alloys		0.0120	0.0078	0.0030	0.0104	0.0791	0.0013	0.0037	0.0029	0.0098	0.0047
		Ferro-silicon ingots	0.0023	0.0017	0.0003	-	0.0001	0.0001	0.0005	-	0.0005	0.0004
		Other iron and steel material including ferro-alloys	0.0097	0.0061	0.0027	0.0104	0.0790	0.0012	0.0032	-	0.0093	0.0043
341-3	Iron and steel castings and forgings		0.0068	0.0041	0.0298	0.0240	N.A.	N.A.	0.1110	0.0919	0.0986	0.0955
341-4	Iron and steel structurals		0.0241	0.0252	0.0346	0.0308	0.0198	0.0330	0.0124	0.0122	0.0205	0.0206
		Plates, sheets, strips	0.0047	0.0028	0.0015	0.0008	0.0197	0.0286	0.0027	0.0023	0.0070	0.0049
		Angles, channels, shapes	0.0008	0.0002	0.0010	-	-	0.0030	0.0009	0.0006	0.0016	0.0019
		Grinders, beams and joists	-	-	-	-	-	0.0005	0.0002	0.0001	0.0006	0.0002
		Bars and rods	0.0186	0.0222	0.0321	0.0301	0.0001	0.0009	0.0086	0.0092	0.0113	0.0136
341-5	Iron and steel pipes	Iron and Steel pipes and tubes	0.1112	0.0218	-	-	-	-	0.0029	0.0050	0.0113	0.0060
341-6	Special steels		-	0.0053	0.0001	0.0001	0.0172	0.1109	0.0428	0.0382	0.0352	0.0337
		Stainless steel	-	-	-	-	-	-	-	-	-	-
		Special steel	-	0.0039	-	-	0.0163	0.1083	0.0421	0.0372	0.0318	0.0310
		High-speed steel	-	0.0014	0.0001	0.0001	0.0009	0.0017	0.0007	0.0010	0.0031	0.0020
		Steel shaft	-	-	-	-	-	0.0009	-	-	0.0003	0.0007
342	Non-ferrous basic metal industries		0.0197	0.0177	0.0380	0.0253	0.0050	0.0047	0.0234	0.0231	0.0264	0.0211
		Copper	0.0018	0.0024	-	-	0.0001	0.0003	0.0008	0.0012	0.0019	0.0023
		Brass	-	-	-	-	0.0003	-	0.0002	0.0002	0.0007	0.0010
		Bronze	-	0.0010	0.0004	0.0028	0.0009	0.0011	0.0081	0.0105	0.0056	0.0076
		Aluminium	0.0053	0.0048	0.0016	0.0002	0.0014	0.0015	0.0102	0.0087	0.0121	0.0058

(continued)

Table 3.1 : (continued)

Group Code No.	Group in A.S.I. Classification	Name of Input	I		II		III		IV		All India	
			Mysore	Kirloskar	Investa		Praga		H.M.T.		1962	1963
		Tin	-	0.0001	-	-	-	-	-	-	0.0001	-
		Lead	-	-	-	-	0.0011	-	-	-	0.0001	0.0001
		Nickel	-	-	-	-	-	0.0018	0.0006	0.0003	0.0008	0.0004
		Gunmetal	0.0004	0.0009	-	-	0.0012	-	0.0001	0.0002	0.0003	0.0010
		Others (including alloys)	0.0122	0.0085	0.0360	0.0223	-	-	0.0030	0.0002	0.0047	0.0029
350-3	Bolts, nuts, nails, screws, springs, chains etc.		0.0018	0.0017	-	0.0093	0.0001	0.0013	0.0067	0.0066	0.0071	0.0066
360-6.1	Ball, roller and tapered bearings		0.0110	0.0077	0.0216	0.0203	0.0010	0.0002	0.0204	0.0154	0.0194	0.0152
360-4	Major items of specialised equipment used in specific industries		0.0266	0.1329	0.1398	0.0812	0.0220	0.1122	0.0779	0.0934	0.1076	0.1186
370-1.2	Electrical motors		0.0546	0.0543	0.0549	0.0528	-	0.0018	0.0324	0.0349	0.0285	0.0309
370-1.6	Electrical cables and wires		0.0021	0.0014	0.0013	0.0040	-	-	0.0012	0.0011	0.0009	0.0015
399-14	Wrapping, packing, filling etc., of articles		0.0234	0.0173	0.0084	0.0156	0.0023	0.0005	0.0312	0.0161	0.0241	0.0142
311	Basic industrial chemicals		0.0119	0.0097	0.0175	0.0166	0.0017	0.0004	0.0188	0.0191	0.0138	0.0134
		Oxygen, acetylene	0.0001	0.0001	-	0.0014	0.0016	0.0002	0.0003	0.0003	0.0004	0.0004
		Others	0.0118	0.0096	0.0175	0.0152	0.0001	0.0002	0.0185	0.0188	0.0134	0.0130
313	Paints and varnishes		0.0166	0.0158	0.0051	0.0052	0.0013	0.0002	0.0036	0.0044	0.0038	0.0045
X		Consumable stores	0.1487	0.1281	0.0077	0.0083	0.0342	0.0719	0.0336	0.0486	0.0304	0.0458
X		Materials consumed for repairs and maintenance	N. A.	N. A.	N. A.	N. A.	0.0035	0.0195	0.0085	0.0080	0.0099	0.0082
X		Timber other than for packing	0.0012	0.0007	0.0016	0.0015	0.0079	0.0009	0.0015	0.0013	0.0018	0.0013
X		<u>Total materials used</u>	0.4604	0.5176	0.3600	0.3477	0.2779	0.3845	0.4534	0.4469	0.4657	0.4850

a/ Includes castings and forgings.

Source: i) Data from individual firms.

ii) Government of India, Central Statistical Organization (Industrial Statistics), Department of Statistics, Calcutta, Annual Survey of Industries 1962 and 1963, Vol. VIII, Manager of Publications, Delhi, 1967.

(continued)

Table 3.1 : (continued)

(11) Fuel and Power

Group Code No.	Group in A.S.I. Classification	Name of Input	I		II		III		IV		V	
			Mysore Kirloskar		Investa		Praga		H.M.T.		All India	
			1962	1963	1962	1963	1962	1963	1962	1963	1962	1963
321-1	Petroleum refineries		0.0158	0.0141	0.0022	0.0087	0.0250	0.0202	0.0085	0.0087	0.0090	0.0086
		Petroleum	0.0006	0.0016	-	0.0044	0.0002	0.0004	0.0024	0.0032	0.0022	0.0028
		Other fuel oils	0.0022	0.0009	0.0022	0.0043	0.0186	0.0118	0.0017	0.0014	0.0027	0.0016
		Lubricating oils	0.0130	0.0116	-	-	0.0062	0.0080	0.0044	0.0041	0.0041	0.0042
		Industrial and power alcohol	-	-	-	-	-	-	-	-	-	-
329-2	Soke and derivatives of coal and lignite		0.0075	0.0078	0.0130	0.0136	0.0050	0.0067	0.0014	0.0016	0.0033	0.0037
		Coal	0.0001	0.0003	0.0020	0.0025	0.0008	0.0008	0.0001	0.0001	0.0004	0.0004
		Cake	0.0057	0.0061	0.0100	0.0104	0.0036	0.0050	0.0010	0.0012	0.0025	0.0029
		Coal gas	-	-	-	-	-	-	-	-	-	-
		Firewood	0.0012	0.0012	0.0010	0.0007	0.0006	0.0006	0.0002	0.0002	0.0003	0.0003
		Charcoal	0.0005	0.0002	-	-	-	0.0003	0.0001	0.0001	0.0001	0.0001
511	Electric light and power	Electricity purchased	0.0132	0.0100	0.0132	0.0160	0.0146	0.0205	0.0112	0.0147	0.0117	0.0130
		Water	-	-	0.0009	0.0016	0.0008	0.0010	0.0020	0.0019	0.0019	0.0017
		Others	0.0004	0.0003	-	-	0.0002	0.0003	0.0060	0.0001	0.0041	0.0001
		Total fuel, electricity and lubricants used	0.0369	0.0322	0.0293	0.0399	0.0456	0.0486	0.0290	0.0270	0.0299	0.0271
X		Work done by other concerns	N.A.	N.A.	N.A.	N.A.	0.0003	0.0020	0.0081	0.0149	0.0125	0.0174
X		Inward transport charges, taxes and duties on purchases etc.	N.A.	N.A.	N.A.	N.A.	0.0150	0.0094	0.0209	0.0188	0.0248	0.0171
X		Non-industrial services purchased	N.A.	N.A.	N.A.	N.A.	0.0057	0.0082	0.0233	0.0249	0.0231	0.0269
		Total services used	N.A.	N.A.	N.A.	N.A.	0.0210	0.0196	0.0523	0.0586	0.0604	0.0613

Sources : 1) Data from the firms.

ii) Government of India, Central Statistical Organisation (Industrial Statistics Wing), Calcutta. Annual Survey of Industries for 1962 and 1963, Vol. VIII, Manager of Publications, Delhi, 1967.

Table 3.2 : Inventory Coefficients

Code No. in ASI classi- fication	Sub-Group Name of Input	A		B	C	D		E	
		Mysore Kirloskar		Investa	Cooper	Praga		H.M.T.	
		1962	1963	1962	1963	1962	1963	1962	1963
	1	2	3	4	5	6	7	8	9
341-1	Iron and Steel (Metal)	0.0181	0.0027	0.0078	0.0843	0.0140	0.0062	0.0641	0.0228
341-2	Ferro-alloys	0.0044	0.0034			0.0215	0.0142		
341-3	Iron and Steel castings	0.0011	0.0032			0.0336	0.0276		
341-4	Iron and Steel structurals	0.0220	0.0159	0.0505	0.0380	0.4049	0.2352	0.0779	0.0499
341-5	Iron and Steel pipes	0.0095	0.0102			0.0045	0.0022		
341-6	Special Steels	0.0009	0.0012						
342	Non-ferrous metals and alloys	0.0014	0.0008	0.0676	0.0114	0.0076	0.0043	0.0354	0.0279
350-3	Bolts, nuts, nails, washers, etc.	0.0108	0.0104	0.0250	-	0.0073	0.0052	0.0080	0.0043
350-10	Hand tools and small tools	0.0162	0.0138	0.0619	-	0.0364	0.0287	0.1280	0.0742
350-14	Others	0.0048	0.0025	-	-	0.0096	0.0060	-	-
360-5	General items of machinery used in several industries	0.0025	0.0018	0.0863	0.0573	0.0601	0.0543	0.0180	0.0193
360-6	Ball bear and tapered bearings	0.0057	0.0074	0.0274	0.0156	0.0131	0.0111	0.0038	0.0019
360-13	Others	0.0002	0.0001	-	-	-	-	0.0052	0.0074
370	Manufacture of electrical machinery and appliances	0.0173	0.0128	0.0194	0.0630	0.0501	0.0319	0.0426	0.0228
370-1-2	Electrical motors	0.0145	0.0104	0.0182		0.0380	0.0256		
370-1-6	Electrical cables and wires	0.0011	0.0006	0.0012		0.0044	0.0032		
370-4	Others	0.0017	0.0018	-	-	0.0077	0.0031	-	-
391	Scientific Instruments	0.0003	0.0003	-	-	0.0075	0.0059	-	-
399-14	Wrapping, packing of articles	0.0003	0.0001	-	0.0005	0.0055	0.0059	0.0053	0.0011
300	Manufacture of rubber products	0.0019	0.0011	-	-	-	-	-	-
311	Basic industrial chemicals	0.0004	0.0003	0.0002	-	0.0063	0.0038	-	-
313	Manufacture of paints, varnishes etc.	0.0014	0.0019	0.0011	0.0023	0.0011	-	-	-
321	Petroleum Products	0.0015	0.0011	-	-	0.0066	0.0060	-	-
329-1	Coke and derivatives	-	-	-	-	0.0017	0.0017	-	-

The dash (-) indicates that the data were not available.

Source : Data from the firms.

Table 3.3 : Capital Coefficients^{a/} (Unadjusted)

Year	Land	Buildings	Plant and Machinery	Electrical Installations	Factory, drawing and laboratory equipment	Furniture and fixtures	Vehicles	Total fixed assets
1955-56	0.0270	0.6638	3.0334	0.0886	0.1132	0.0800	0.0364	4.0590
1956-57	0.0267	0.5824	2.7065	0.0995	0.1491	0.0776	0.0597	3.7035
1957-58	0.0111	0.3072	1.1138	0.0533	0.0830	0.0436	0.0308	1.6447
1958-59	0.0099	0.2955	0.8463	0.0410	0.0718	0.0383	0.0297	1.3279
1959-60	0.0124	0.3214	0.8799	0.0412	0.0775	0.0431	0.0334	1.4089
1960-61	0.0157	0.3070	0.7816	0.0429	0.0674	0.0395	0.0364	1.2925
1961-62	0.0142	0.3884	0.7264	0.0483	0.0756	0.0367	0.0310	1.3206
1962-63	0.0144	0.3496	0.6826	0.0535	0.0739	0.0344	0.0269	1.2353
1963-64	0.0148	0.3290	0.6485	0.0464	0.0592	0.0293	0.0223	1.1495

^{a/} Based on gross capital.

Source : Data from the four firms.

Table 3.4 : Capital Coefficients ^{a/} (Adjusted for Price Changes)

Year	Total for four firms				
	Buildings	Plant and machinery	Electrical Installations	Vehicles	Total fixed Assets
1955-56	0.6438	2.9421	0.0859	0.0353	3.9369
1956-57	0.5728	2.7066	0.0995	0.0597	3.7036
1957-58	0.3516	1.2867	0.0652	0.0355	1.8980
1958-59	0.3748	1.1098	0.0573	0.0397	1.7369
1959-60	0.3735	1.0588	0.0534	0.0416	1.6835
1960-61	0.3571	0.9396	0.0576	0.0457	1.5416
1961-62	0.4871	0.9458	0.0703	0.0436	1.7020
1962-63	0.4427	0.8816	0.0810	0.0385	1.5913
1963-64	0.4343	0.8725	0.0759	0.0342	1.5430

^{a/} Based on gross capital.

Source : Data from the four firms.

Table 3.5 : Capital Coefficients (Adjusted for Price Changes) - For Four Firms Separately

Year	Plant and Machinery (Gross)				Total Fixed Assets (Gross)			
	Mysore Kirloskar	Investa	Praga	H.K.T.	Mysore Kirloskar	Investa	Praga	H.K.T.
1955-56	0.7146	1.2987	1.1356	390.9027	1.0381	1.6673	1.5770	506.5835
1956-57	0.7556	1.0908	-	6.4716	1.1653	1.4212	-	8.6931
1957-58	0.6275	0.7646	0.7161	2.2980	0.9551	1.0131	0.9956	3.4350
1958-59	0.5957	0.6141	0.7669	1.6920	0.9153	0.8290	1.0816	2.7327
1959-60	0.5333	0.6409	1.0634	1.3834	0.8407	0.8615	1.4863	2.2924
1960-61	0.6102	1.0907	1.6090	0.9934	0.9219	1.6747	2.3309	1.7405
1961-62	0.5129	2.2177	1.7122	1.0345	0.8480	3.1392	2.5290	1.9756
1962-63	0.4968	2.3656	1.3652	0.9438	0.7641	3.2185	2.0445	1.8440
1963-64	0.5445	2.6487	1.5505	0.8415	0.7778	3.2448	2.2722	1.6947

Source : Data from the firms.

Table 3.6 : Price Indices for Capital Assets (Base 1956-57 = 100)

Year	Buildings (wt)		Plant and (wt) Machinery		Electrical (wt) Appliances		Automobiles (wt)		Combined weighted Index for Assets
1956-57	100	(8)	100.0	(36)	100.0	(1)	100.0	(1)	100.0
1957-58	103.5	(9)	101.9	(34)	87.8	(1)	102.0	(1)	101.9
1958-59	114.1	(11)	109.4	(32)	85.8	(1)	93.0	(1)	109.7
1959-60	114.1	(12)	114.7	(31)	84.3	(1)	94.1	(1)	113.4
1960-61	114.7	(12)	118.9	(30)	87.6	(1)	99.7	(1)	116.6
1961-62	117.3	(14)	122.9	(28)	87.9	(2)	100.9	(1)	119.2
1962-63	119.9	(14)	126.4	(28)	90.3	(2)	101.1	(1)	122.2
1963-64	133.6	(15)	130.6	(28)	92.9	(2)	104.1	(1)	129.4

Source : Government of India, Department of Supply, Directorate General of Supplies and Disposals, Index Numbers of Purchase Prices for 1963-64. Statistics Directorate, New Delhi 1965, pp. 28-29.

Table 3.7 : Price Indices for Output

Year	I		II		III		IV		Total for four firms
	Mysore Kirloskar	(wt)	Investa	(wt)	Praga	(wt)	H.M.T.	(wt)	
1955-56	99	(5)	80	(1)	100	(4)	75	(0.1)	97
1956-57	100	(5)	100	(1)	-	-	100	(3)	100
1957-58	98	(4)	116	(0.4)	110	(4)	130	(7)	116
1958-59	111	(5)	128	(0.4)	108	(4)	152	(10)	132
1959-60	110	(3)	132	(1)	79	(1)	128	(6)	122
1960-61	117	(4)	140	(1)	122	(1)	127	(8)	124
1961-62	105	(2)	170	(1)	165	(1)	147	(6)	139
1962-63	101	(3)	171	(1)	125	(1)	159	(8)	142
1963-64	113	(3)	168	(1)	147	(1)	169	(8)	153

Source : Computed from the annual production data of the firms.

Table 3.8 : Capital Coefficients Based on Data for Two Firms (for Machine Shop only)

<u>Firm A</u>			
(Without Market Restraints)			
Optimum Capacity Production: Rs.1,41,53,650			
Sl. No.	Capital Facilities	Estimated gross value of utilized facilities (Rs.)	Capital Coefficient
1.	Centre lathes	36,539	0.0026
2.	Capstan lathes	338,241	0.0239
3.	Turret lathes	52,106	0.0037
4.	Horizontal milling	83,526	0.0059
5.	Vertical milling	130,296	0.0092
6.	Key-way milling	6,586	0.0005
7.	Thread milling	120,234	0.0085
8.	Filler drilling	3,331	0.0002
9.	Radial drilling	78,045	0.0055
10.	Horizontal boring (upto 100 mm)	144,849	0.0102
11.	Horizontal boring BFT-125	324,408	0.0229
12.	Vertical boring (Stirk)	22,582	0.0016
13.	Vertical boring (Bulard)	8,348	0.0006
14.	Jig-milling 2B-36	268,263	0.0190
15.	Jig-milling 3H-48	259,768	0.0184
16.	Cylindrical grinding upto 150 x 750	85,984	0.0061
17.	Cylindrical grinding column grinding	27,711	0.0019
18.	Internal grinding	94,582	0.0067
19.	Surface grinding reciprocating	100,965	0.0071
20.	Surface grinding rotary	22,043	0.0016
21.	Guideway grinding	161,231	0.0114
22.	Gear grinding	102,041	0.0072
23.	Spline grinding	9,446	0.0007
24.	Shaping	38,267	0.0027
25.	Slotting	416	0.0000
26.	Planing	1,023,023	0.0723
27.	Gear-cutting	41,934	0.0030
28.	Broaching	43,766	0.0031
Total All Items		3,628,500	0.2564

(continued)

Table 3.8 : (continued)

<u>Firm B</u>			
<u>(Without Market Restraints)</u>			
Optimum Capacity Production: Rs.41,51,774			
Sl. No.	Capital Facilities	Estimated gross value of utilized facilities (Rs.)	Capital Coefficient
1.	Planing	1,249,631	0.3009
2.	Horizontal boring	268,627	0.0647
3.	Vertical boring	469,128	0.1130
4.	Horizontal milling	82,363	0.0198
5.	Vertical milling	108,835	0.0262
6.	Shaping	18,615	0.0045
7.	Gear hobbing	45,218	0.0109
8.	Heavy duty turret	208,671	0.0503
9.	Heavy and Medium centre lathes	87,629	0.0211
10.	Light centre lathes	9,236	0.0022
11.	Capstan	61,919	0.0149
12.	Slotting	8,484	0.0020
13.	Cylindrical grinding	12,480	0.0030
14.	Internal grinding	19,742	0.0048
15.	Surface grinding	7,309	0.0018
16.	Sensitive drilling	3,263	0.0008
17.	Radial drilling	56,634	0.0136
Total All Items		2,717,749	0.6546

Source: Chapter 8, Tables 8.5 and 8.6.

Table 3.9 : The Cost of Production Per Rupee of Output

Item	Firm A	Firm B	Firm C	Firm D
Direct materials	0.42	0.41	0.34	0.38
Direct Labour	0.11	0.10	0.08	0.07
Prime Cost	<u>0.53</u>	<u>0.51</u>	<u>0.42</u>	<u>0.45</u>
Power and fuel	0.01	0.02	0.02	0.01
Stores and spares	0.04	0.03	0.03	0.04
Repairs and maintenance	Neg.	0.01	0.01	0.01
Indirect labour	0.04	0.03	0.08	0.07
Other manufacturing expenses	<u>0.10</u>	<u>0.09</u>	<u>0.14</u>	<u>0.13</u>
Depreciation	0.09	0.07	0.07	0.08
Salaries	0.10	0.11	0.13	0.12
Royalties	0.01	0.01	Neg.	0.01
Managing agent's remuneration	-	0.03	-	0.02
Interest	0.02	0.02	0.03	0.06
Office and administration overheads	0.09	0.11	0.19	0.29
Profit (or Loss)	0.07	0.05	0.01	(0.16)
Total	1.00	1.00	1.00	1.00

Source : Data from the firms.

CHAPTER 4FINANCES OF MACHINE TOOL COMPANIES

In this chapter, funds-flow statements and selected financial ratios of nine machine tool companies are presented from 1956 through 1966, with a view to examine their financial performance. Together, these nine firms account for about 80 per cent of the production of the graded machine tools in India at present. Six of these firms are public limited companies, one private limited and the remaining two are in the public sector. Among themselves, the firms differ greatly in size, according to total assets.

The Hindustan Machine Tools Ltd. (HMT) with its total assets of Rs. 38 crores, is the largest in size, while the Crescent Iron and Steel Company Ltd. (CISCO) with Rs. 54 lakhs of total assets, is the smallest. Considering the sales also, HMT is the largest, and CISCO, the smallest. All of them manufacture machine tools and, at times some items of an allied nature. In the case of HMT, Praga, Mysore Kirloskar, Investa and CISCO, the production of machine tools is the major activity, the machine tools forming about more than 90 per cent of the output of each company. Batala's production of machine tools is about 50 to 60 per cent of its annual output. In the case of Cooper, New Standard Engineering (NSE) and Ex-Cell-'O, the machine tools constitute

about 30 to 40 per cent annual output of each company. These companies manufacture other industrial machinery in addition to machine tools. The purpose of inclusion of Cooper, NSE and Ex-Cell-'O while considering the performance of machine tool companies, is to see whether these companies, able to switch over to other lines of production in case the demand for machine tools falls, have done better than other companies, whose major activity is the manufacture of machine tools.

The funds-flow statements and the financial ratios are computed on the basis of data collected from the balance sheets and profit and loss accounts of these companies, published every year. There are certain limitations implicit in the use of these data. The accounting methods, especially the procedures for valuation of inventories and computation of depreciation differ from one company to the other. The figures are not adjusted for changes in the value of money. These and many other limitations inherent in the analysis of financial statements need to be considered while studying conclusions based on the analysis of financial ratios and funds flow statements.

With these caveats, it is seen that there is hardly any pattern in the financial performance of these companies during the last eleven years, and that the companies have reacted differently to the same economic environment. The companies differ widely regarding their rates of growth, methods of financing, turnover and profitability.

The Table 4.1 shows the indices of growth of these companies in terms of sales and total assets.¹ All the firms have grown regarding sales and total assets from 1956 through 1966. Nevertheless, the pace of growth is different for different companies. Between 1956 and 1961, all companies except Praga have doubled their sales. The sales of HMT and CISCO in 1966 are about four times and CISCO in 1966 are about four times their respective sales in 1961.

From 1956 through 1961, the total assets of all companies except Praga, have been more than doubled. Batala, in 1966, had increased its total assets by five times those in 1961. Also striking is the growth of total assets of HMT during 1961-66.

The Table 4.2 indicates the sources and uses of funds of machine tool companies.

During the period from 1956 to 1961, all the companies relied both on owned funds (paid-up capital, reserves and surplus) and debts. The reliance on debts was less in the case of CISCO, Investa, Mysore Kirloskar, Praga and HMT, than in the case of other companies. In fact, Praga and CISCO used some of the funds to decrease their long term and short term debts. During 1961-66, however, CISCO, Investa and Praga seem to rely more on debts than owned funds. Mysore Kirloskar, during this period, continued to finance

¹ All the tables are attached at the end of this chapter.

its growth mainly through internally generated funds. Though the owned funds still formed the main source of capital for HMT, the proportion of its funds from debts has increased in this period than that during 1956-61. NSE's growth during 1961-66 was financed mainly from borrowed capital.

The proportion of short-term debts (payables) in the total borrowings of most of the companies outweighs that of the long term debts. Except Praga and HMT all companies have relied mostly on short term borrowings/ ^{and trade credit} as a source of funds. None of the companies issued any debentures.

The major application of funds is for the purpose of fixed assets. In the case of HMT, Investa and Mysore Kirloskar (and Batala during 1961-66) more than 60 per cent of the funds obtained, were used for the creation of fixed assets. In the case of other companies, about 40 per cent of funds obtained, are invested in fixed assets. For Praga during 1956-61, CISCO during 1961-66, this proportion is still less. In the case of latter companies, funds obtained are mainly employed to finance inventories. Batala during 1956-61, Cooper during 1961-66, have used considerable proportion of funds to finance accounts receivables.

The ratios of total debt to net worth of the machine tool companies given in Table 4.3 show in a pronounced manner, the tendency of the companies to rely more on debt capital than on owned funds especially in later years. Batala, from 1959 onwards, NSE from 1962 onwards seem to be

financing their growth mainly out of borrowed funds. Cooper has relied on borrowed funds from 1956 through 1966 to a considerable extent. CISCO and Investa have decreased their debts during 1958-60, but their growth in later years is financed mainly through borrowed funds. Praga (after it was taken over by the Government of India in 1958) and HMT have been financed by way of owned funds. After 1964, however, a change in the government policy is discerned and capital is supplied by way of loans.

The heavy reliance of the companies on borrowed funds, especially since 1961-62 onwards is, in part, attributable to the tight nature of the capital market from the point of view of machine tool industry. The capital market in recent years has shown a distinct preference to fixed return investments as opposed to ordinary shares. The Index of Variable Dividend Securities which increased from 125.4 in 1957-58 to 183.7 in 1961-62, decreased to 163.9 in 1964-65 (base 1952-53 = 100). This Index has further decreased from 86.1 in 1964-65 to 73.2 in February 1968 (base 1961-62 = 100).¹ The market prices of ordinary shares of the machine tool companies in the private sector continued to fall since 1962-63. Thus companies have financed their day-to-day operations as well as growth through borrowed funds. Companies

¹ The Reserve Bank of India, Bombay. Reserve Bank of India Bulletin, Vol. XIX, No. 6, June 1965, pp. 955-56 and Vol. XXII, No. 2, February 1968, p. 243.

by this method, increase their burden of fixed interest charges, but they also obtain the necessary capital without diluting the ownership of the existing shareholders. Very few companies, such as Mysore Kirloskar or Cooper are in a strong economic position and do not run the risk of not meeting their obligations. However, even the position of financially secure companies becomes precarious in the situation when costs of materials and labour increase and sufficient demand for the products does not generate, as has been the case during the last three years. From this point of view, the wisdom of policy of relying more on debts than the sale of ordinary shares, even during the years from 1956-57 to 1961-62, when the capital market was favourable to machine tool companies, may be questioned.

The specialized financial institutions set up by the Government of India, such as The Industrial Finance Corporation of India, The Industrial Credit and Investment Corporation of India etc. have made loans to the selected machine tool companies. Additional funds have been made available to the companies, by the Governments of the States, in which they are located. Such help has, no doubt, assisted the companies to establish new factories and expand the existing ones, though, from the point of view of machine tool industry in general, it must be inadequate considering the needs of companies.

The turnover ratio (net sales to total assets) (Table 4.3) indicates to what extent the assets are efficiently used.

The ratio ranges from 141 per cent Bata for in 1961 to 1 per cent for HMT in 1956. The performance of HMT improved in later years. The turnover ratio has generally decreased during years when substantial expansion in the company's assets took place. Generally a hundred per cent turnover is said to be desirable in the machine tool industry. Applying this rough yardstick, the companies seem to have exceeded this norm only in few years. During 1965 and 1966, the turnover ratios for Bata, Mysore Kirloskar, NSE, Praga and HMT decreased, probably because of recession in the industry. Cooper during these years curtailed its production of machine tools and concentrated on diesel oil engines, which probably accounts for its high turnover ratios during this period.

The ratios of net profits (after taxes) to net sales and earnings (before interest, taxes and managing agents' remuneration) to sales, may help to appraise the efficiency of operations. These measures are of limited use, as methods of pricing the products; the composition of products methods of financing etc. are different for different companies.

As far as ratios of earnings to net sales and net profits (after taxes) to sales are considered, HMT has shown the best performance. Its earnings to sales ratio was as high as 33 per cent in 1963 and 1964. The net profits (after taxes) to sales ratio for HMT 27 per cent in 1962.

After HMT, the performance of Mysore Kirloskar is noteworthy. The reasons for the good performance of HMT and Mysore Kirloskar may be found in their economy of operations and saleability of their products. Both, more or less financed through owned funds, have kept their interest charges at a lower level than other companies. The performance of Investa and Praga is uneven, showing good profits in a few years and losses or scanty profits in most of the years. Excell-'O improved its performance from 1962 onwards. Batala, Cooper and NSE have shown profits in most of the years but their profitability, when compared to that of HMT and Mysore Kirloskar, is not significant. At the same time, their overall performance is much better than that of Investa and Praga.

The ratio of net profits (after taxes) to total assets indicates the earning power of the assets. Here again, the performance of HMT and Mysore Kirloskar is much better than that of other companies. Investa and Praga can be said to have done badly in this respect.

There is no correlation between total assets and net sales to total assets, or between total assets and net profits (after tax) to total assets. The coefficients of rank correlation, as computed on the basis of 1964-data, are shown in Table 4.4. (In recent years, the performance of companies may be differently affected because of recession in the industry. Hence, the data for these years are not considered.)

The rank correlation coefficient for total assets with net sales/total assets, for nine companies is 0.02, which is not significant under the null hypothesis ($p > 0.11$). Similarly, the rank correlation coefficient for total assets with net profits (after tax)/total assets (0.15) is/significant under the null hypothesis ($p > 0.11$). For five companies, which were primarily engaged in the production of machine tools, also, the rank correlation coefficient for total assets with net sales/total assets (0.20), and that for total assets with net profits/total assets (0.70) are not significant under the null hypothesis ($p > 0.12$ and $p = 0.12$ respectively).¹

Thus, it may be concluded that, as far as these data are concerned, the observed values do not offer evidence against the null hypothesis. There does not appear to be any relationship between the size of total assets and turnover or profitability of the firms.

Except Investa, Praga and Excell'O most other companies have paid good dividends. HMT did not pay any dividends upto 1960 and in 1966 and has chosen to retain a major portion of its net profits except in 1961. Mysore Kirloskar also in most of the years, has ploughed its profits back into the

¹ Values of rank correlation coefficients at relevant significance points are consulted from the table in the book by A. L. Edwards, Statistical Methods (Second Edition). H. O. Rinehart and Winston, Inc., New York etc: 1967, p. 437.

business. The ratio fluctuates in the case of other companies, and does not indicate any settled policy regarding payment of dividends.

The ratios of cost of goods sold to net sales indicate (Table 4.3) the high portion of expenses on raw materials, fuels, stores, repairs, depreciation, and wages and salaries in the case of all companies. Very high ratios for HMT in 1956 and 1957 and for Excell'0 in 1960 are obviously due to circumstances when the output was not sold and may be considered atypical. Otherwise, the ratio varies from 107 per cent in the case of Praga in 1956 to 64 per cent for Investa in 1962. The low ratio for Investa does not however indicate that the expenses had fallen in absolute terms. The high ratio of operating costs to net sales in the same year (for Investa) has led to a decrease in the ratio of cost of goods sold to net sales.

Compared to the cost of goods sold, the expenses on office administration, and other items are low in the case of companies, though the ratio of operating costs to net sales (Table 4.3) varies from company to company and from year to year. No specific trends are discernible in these two ratios over years.

The equity share data for four public limited companies during 1963-66 is given in Table 4.5. The market price of the equity share has decreased for all these companies from 1963 through 1966 denoting the less favourable evaluation of

the shares of the companies by the investors over the period. The yield rate varies from about 12 per cent for Cooper in 1966 to nil for Batala in 1965. The earnings rate shows wider variations than the yield rate. The earnings rate is the highest for Mysore Kirloskar in 1965 (about 33 per cent) and lowest for Cooper in 1964 (about 3 per cent).

The discrepancy between the yield rate and the earnings rate in the case of Mysore Kirloskar is not likely to attract potential investors. In the case of NSE, Cooper and Batala also, the difference between the earnings rate and yield rate is seen to be increasing during 1965 and 1966. A potential investor, if the machine tool companies continue to follow this policy, is likely to look towards other more attractive investment opportunities.

The funds flow statements and selected financial ratios give an appearance of great diversity in the financial performance and policies of machine tool companies in many respects. The similarity is to be found in the case of methods of financing in that most companies rely on borrowed funds in preference to owned capital. Many companies have raised short term funds, as the banks seem more willing to give short term credit to the companies against the security of raw materials and finished products stocks. The availability of credit on these terms have encouraged some companies to keep their stocks and plants continuously mortgaged and thus secure funds not available otherwise.

The profitability of companies is different for different companies. It is also different for different years. The policies of paying dividends and retention of profits differ for different companies. In this respect, the companies do not conform to a particular pattern. The performance of the companies is very much dependent on the methods of pricing the products, the market for the products, and the efforts of the companies to promote their sales. These aspects are discussed in the next chapter.

Table 4.1 : Indices of Growth

Year	Total Assets (Rs. in Thousands) (1961 as Base)																	
	Batala ^{a/}		CISCO		Investa		Mysore Kirloskar		Cooper		H.S.E.		Praga ^{b/}		H.M.T.		Excell-O	
1956	1781	(51)	1311	(58)	4341	(40)	7074	(39)	7996	(28)	-	8914	(57)	48349	(50)	-		
1957	1841	(52)	1392	(62)	4439	(41)	8217	(45)	8980	(31)	-	-		60797	(63)	-		
1958	2533	(72)	1531	(68)	4684	(43)	9223	(50)	10103	(35)	-	10164	(65)	77468	(80)	-		
1959	3150	(90)	1697	(76)	4932	(46)	14498	(79)	12970	(46)	-	14899	(96)	81863	(85)	-		
1960	3972	(113)	1870	(83)	6090	(56)	16154	(88)	17301	(61)	8858	(58)	15552	(100)	78397	(81)	4890	(62)
1961	3508	(100)	2242	(100)	10843	(100)	18536	(100)	28523	(100)	15211	(100)	15542	(100)	96372	(100)	7862	(100)
1962	4780	(136)	2918	(130)	15522	(143)	20855	(114)	34410	(121)	20434	(134)	18988	(122)	123740	(128)	10173	(129)
1963	7525 (8094)	(215) (231)	3343	(149)	20758	(191)	25650	(140)	37115	(130)	26193	(172)	23423	(151)	153749	(160)	11023	(140)
1964	9875	(281)	4597	(205)	23300	(215)	37493	(204)	36751	(129)	31778	(209)	29898	(192)	218478	(227)	12257	(156)
1965	14202	(405)	4977	(222)	-		46414	(253)	40224	(141)	38075	(250)	37064	(238)	298650	(310)	-	
1966	16368	(467)	5419	(242)	-		55100	(301)	61456	(215)	43671	(287)	43835	(282)	376851	(391)	-	

^{a/} The figures in brackets for Batala in 1963 are for 9 months ended 31-12-1963.

^{b/} In 1957, Praga did not publish its accounts. After 18 months, it published its report on 30th June 1958.

Source : Balance Sheets of the companies.

(continued)

Table 4.1 : (continued)

Net Sales (Rs. in Thousands) (1961 as Base)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Excell-0
1956	1343 (27)	600 (48)	1330 (29)	4517 (25)	7477 (36)	-	4305 (61)	330 (1)	-
1957	2004 (40)	711 (57)	1608 (33)	5443 (30)	9074 (44)	-	-	4191 (13)	-
1958	2513 (51)	853 (69)	2517 (56)	8662 (47)	12446 (60)	-	7538 (108)	14830 (44)	-
1959	3333 (67)	960 (77)	3310 (73)	10537 (57)	15902 (77)	-	7389 (106)	20286 (60)	-
1960	4036 (81)	934 (75)	4465 (99)	14075 (77)	20307 (99)	9337 (78)	4801 (69)	22593 (67)	170 (10)
1961	4963 (100)	1244 (100)	4509 (100)	18378 (100)	20606 (100)	11987 (100)	6976 (100)	33619 (100)	1695 (100)
1962	4433 (90)	1820 (146)	5892 (131)	20793 (113)	19644 (95)	16028 (134)	7925 (113)	47628 (142)	4544 (268)
1963	6539 (132) (6354) (128)	2103 (169)	6340 (141)	23175 (126)	26888 (130)	18291 (153)	7784 (112)	70823 (211)	9986 (589)
1964	8113 (163)	2867 (230)	7725 (171)	31018 (169)	31472 (153)	24029 (200)	10768 (154)	98271 (292)	14270 (841)
1965	5998 (121)	3982 (320)	-	38752 (211)	48570 (236)	30778 (256)	14745 (211)	129169 (384)	-
1966	10266 (207)	4634 (373)	-	39465 (215)	61852 (300)	29943 (250)	12803 (184)	125105 (372)	-

Source : Profit and Loss Statements of the Companies.

Table 4.2 : Sources and Uses of Funds

	Batala						CISCO					
	1956-61	%	1961-66	%	1956-66	%	1956-61	%	1961-66	%	1956-61	%
Increase in paid up capital	175	9	2917	20	3092	18	-	-	526	14	311	6
Funds from depreciation	319	16	1952	13	2271	13	382	19	684	18	1066	20
Increase in reserves	268	13	959	6	1227	7	241	12	386	10	627	11
Increase in surplus	-	-	0	0	-	-	532	27	-	-	528	10
Increase in long-term debts	0	0	1211	8	1211	7	-	-	0	0	-	-
Increase in payables (to creditors)	1007	50	7740	52	8747	52	709	37	1833	49	2542	46
Increase in accrued taxes	53	3	-	-	2	Neg.*	-	-	243	6	233	4
Increase in accrued dividends	127	6	83	1	210	1	72	4	79	2	151	3
Decrease in investments	-	-	31	Neg.	7	-	-	-	-	-	-	-
Decrease in receivables (from debtors)	-	-	-	-	60	-	-	-	-	-	-	-
Decrease in tax-deposits	60	3	-	-	-	-	-	-	-	-	-	-
Total Sources	2009	100	14893	100	16727	100	1936	100	3751	100	5458	100
Increase in plant and machinery (gross)	294	15	4762	32	5056	30	450	23	757	20	1207	22
Increase in other fixed assets (gross)	524	26	4703	32	5227	31	271	14	442	12	713	13
Increase in cash	19	1	804	5	823	5	1	-	34	1	35	1
Increase in inventory	450	22	3447	23	3897	23	514	27	1670	45	2184	40
Increase in investments	24	1	-	-	-	-	0	0	19	Neg.	19	Neg.
Increase in receivable (from debtors)	558	28	595	4	1153	7	78	4	463	12	541	10
Increase in miscellaneous current assets	16	1	146	1	162	1	0	0	30	1	30	1
Increase in tax deposits	-	-	0	0	-	-	0	0	332	9	332	6
Increase in other assets	0	0	385	3	385	2	0	0	0	0	0	0
Decrease in paid up capital	-	-	-	-	-	-	215	11	-	-	-	-
Decrease in surplus	124	6	-	-	124	1	-	-	4	Neg.	-	-
Decrease in long term debts	-	-	-	-	-	-	397	21	-	-	397	7
Decrease in accrued taxes	-	-	51	Neg.	-	-	10	1	-	-	-	-
Total Uses	2009	100	14893	100	16827	100	1936	100	3751	100	5458	100

*Neg. - Negligible.

(continued)

Table 4.2 : (continued)

	Investa						Mysore Kirloskar					
	1956-61	%	1961-64	%	1956-64	%	1956-61	%	1961-66	%	1956-66	%
Increase in paid up capital	1500	20	3739	25	5239	24	2698	19	6961	14	9779	16
Funds from depreciation	1111	15	1578	11	2689	12	2690	19	11499	24	14189	23
Increase in reserves	290	4	399	3	689	3	2484	18	8868	18	11352	18
Increase in surplus	866	11	-	-	812	4	3	Neg.	-	-	-	-
Increase in long term debts	0	0	4862	33	4862	22	1693	12	-	-	1043	2
Increase in payables (creditors)	3741	49	3657	25	7398	34	1862	13	16668	34	18530	30
Increase in accrued taxes	93	1	-	-	0	0	1786	13	4164	9	5950	10
Increase in accrued dividends	12	Neg.	-	-	-	-	458	3	539	1	997	2
Decrease in cash	-	-	14	Neg.	5	Neg.	224	2	-	-	94	Neg.
Decrease in miscellaneous current assets	-	-	-	-	-	-	-	-	20	Neg.	-	-
Decrease in other assets	-	-	357	2	-	-	0	0	-	-	-	-
Total Sources	7613	100	14606	100	21694	100	14042	100	48739	100	61968	100
Increase in plant and machinery (gross)	2563	34	5532	38	8095	37	4948	35	22610	46	27558	45
Increase in other fixed assets (gross)	3329	44	5327	36	8656	40	2738	20	7762	16	10500	17
Increase in cash	9	Neg.	-	-	-	-	-	-	130	Neg.	-	-
Increase in inventory	728	10	3342	23	4070	19	3001	21	7927	16	10928	18
Increase in investment	0	0	0	0	0	0	0	0	399	1	399	1
Increase in receivables (from debtors)	459	6	185	1	644	3	2620	19	3765	8	6385	10
Increase in miscellaneous current assets	4	Neg.	15	Neg.	19	Neg.	298	2	-	-	278	Neg.
Increase in tax-deposits	0	0	0	0	-	-	437	3	5014	11	5451	9
Increase in other assets	521	6	-	-	174	1	0	0	478	1	478	1
Decrease in surplus	-	-	54	Neg.	-	-	-	-	4	Neg.	1	Neg.
Decrease in long term debts	-	-	-	-	-	-	-	-	650	1	-	-
Decrease in accrued taxes	-	-	93	1	-	-	-	-	-	-	-	-
Decrease in dividends payable	-	-	52	-	40	Neg.	-	-	-	-	-	-
Total Uses	7613	100	14606	100	21694	100	14042	100	48739	100	61968	100

(continued)

Table 4.2 : (continued)

	Cooper				N.S.E.			
	1956-61		1961-66		1956-66		1960-61	
	\$	%	\$	%	\$	%	\$	%
Increase in paid up capital	2000	9	9037	20	11037	16	5547	13
Funds from depreciation	1905	8	9754	22	11659	18	6065	15
Increase in reserves	4445	20	3369	8	7814	12	2941	7
Increase in long term debts	500	2	3341	8	3841	6	5946	14
Increase in payables (to creditors)	10181	45	16241	36	26422	40	17754	42
Increase in accrued taxes	2929	13	2034	5	4963	8	2072	5
Increase in accrued dividends	412	2	-	-	-	-	640	2
Decrease in cash	-	-	-	-	-	-	145	Neg.
Decrease in investments	-	-	70	Neg.	68	Neg.	2	Neg.
Decrease in tax deposits	-	-	391	1	-	-	-	-
Decrease in miscellaneous current assets	318	1	-	-	-	-	765	2
Total Sources	22690	100	44237	100	65804	100	41877	100
Income in plant and machinery (gross)	5665	25	11959	27	17624	27	10279	25
Increase in other fixed assets (gross)	3758	17	5713	13	9471	14	7482	18
Increase in cash	639	3	247	1	886	1	-	-
Increase in inventory	8737	38	8022	18	16759	25	13040	31
Increase in investments	2	Neg.	-	-	-	-	-	-
Increase in receivables (from debtors)	2030	9	12498	29	14528	22	8826	21
Increase in miscellaneous current assets	-	-	4113	9	3795	6	-	-
Increase in tax deposits	1829	8	-	-	1438	2	1756	4
Increase in other assets	10	Neg.	597	1	607	1	407	1
Decrease in surplus	20	Neg.	74	Neg.	84	Neg.	87	Neg.
Decrease in dividends payable	-	-	1014	2	602	1	-	-
Total Uses	22690	100	44237	100	65804	100	41877	100

(continued)

Table 4.2 : (continued)

	Praga						H. M. T.					
	1956-61		1961-66		1956-66		1956-61		1961-66		1956-66	
		%		%		%		%		%		%
Increase in paid up capital	6611	54	1365	4	7976	20	19100	29	61900	19	81000	21
Funds for depreciation	2051	17	2874	9	4925	12	9718	15	40214	12	49932	13
Increase in reserves	316	3	1061	3	1377	3	799	1	51221	16	52020	13
Increase in surplus	3076	26	2	Neg.	3078	8	139	Neg.	1082	Neg.	1221	Neg.
Increase in long term debts	-	-	14836	48	13061	33	14129	21	93123	29	107252	28
Increase in payables (to creditors)	-	-	10581	34	9006	23	13856	21	75085	23	88941	23
Increase in accrued taxes	-	-	0	0	-	-	0	0	3493	1	3493	1
Increase in accrued dividends	0	0	449	1	449	1	-	-	-	-	-	-
Decrease in cash	-	-	278	1	-	-	3018	5	-	-	1676	Neg.
Decrease in investments	-	-	-	-	-	-	-	-	6	Neg.	6	Neg.
Decrease in other assets	-	-	-	-	-	-	5122	8	-	-	4037	1
Total Sources	12054	100	31446	100	39872	100	65981	100	326124	100	389578	100
Increase in plant and machinery (gross)	2476	21	11762	37	14238	36	4175	6	99690	31	103865	27
Increase in other fixed assets (gross)	1228	10	6879	22	8107	20	27408	42	144217	44	171625	44
Increase in cash	366	3	-	-	88	Neg.	-	-	1342	Neg.	-	-
Increase in inventory	3815	32	6734	21	10549	26	22972	35	56568	17	79540	20
Increase in investments	0	0	22	Neg.	22	Neg.	0	0	-	-	-	-
Increase in receivables (from debtors)	511	4	4053	13	4564	12	9554	14	11668	4	21222	5
Increase in miscellaneous current assets	0	0	58	Neg.	58	Neg.	1772	3	5458	2	7230	2
Increase in tax deposits	172	1	629	2	801	2	0	0	6096	2	6096	2
Increase in other assets	111	1	1309	Neg.	-	-	-	-	1085	Neg.	-	-
Decrease in paid up capital	-	-	-	-	1420	4	-	-	-	-	-	-
Decrease in long term debts	1775	15	-	-	-	-	-	-	-	-	-	-
Decrease in payables (to creditors)	1575	13	-	-	-	-	-	-	-	-	-	-
Decrease in accrued taxes	25	Neg.	-	-	25	Neg.	-	-	-	-	-	-
Total Uses	12054	100	31446	100	39872	100	65881	100	326124	100	389578	100

Neg. - Negligible.

Source : Balance Sheets of the Companies.

Table 4.3 : Selected Financial Ratios

(1) Total Debt to Net Worth (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	30	252	155	83	114	-	125	24	-
1957	40	204	160	101	138	-	-	54	-
1958	92	99	147	114	144	-	154	99	-
1959	129	105	95	133	131	-	11	67	-
1960	173	113	98	100	144	61	9	46	4582
1961	107	141	149	101	188	80	11	63	(-) 2327
1962	119	146	127	80	135	134	28	70	4094
1963	192 (190)	107	210	100	157	166	57	57	799
1964	155	171	176	119	121	192	94	94	387
1965	252	204	-	102	133	191	131	143	-
1966	194	195	-	120	177	215	168	124	-

(2) Net Sales to Total Assets (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	75	46	31	64	94	-	48	1	-
1957	109	51	36	66	101	-	-	7	-
1958	99	56	54	87	123	-	74	19	-
1959	106	57	67	73	123	-	50	25	-
1960	102	50	73	88	117	105	31	31	3
1961	141	55	42	99	76	79	44	35	22
1962	93	62	38	100	57	78	42	38	45
1963	87 (79)	63	31	90	72	70	32	46	91
1964	82	62	33	83	86	76	36	45	116
1965	42	80	-	83	121	81	40	43	-
1966	62	86	-	72	101	69	29	33	-

(continued)

Table 4.3 : (continued)

(3) Net Profits (after Taxes) to Net Sales (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	7	12	(-) 4	(-)10	4	-	(-)36	0	-
1957	4	9	0	3	2	-	-	10	-
1958	3	10	8	6	4	-	1	15	-
1959	4	11	19	7	5	-	7	16	-
1960	5	11	5	9	5	5	20	15	(-) 310
1961	4	10	6	9	7	8	(-) 5	22	(-) 31
1962	8	10	9	6	(-) 1	6	(-) 6	27	(-) 4
1963	6 (6)	9	(-) 2	8	2	5	0	24	9
1964	6	7	0	10	1	5	5	25	10
1965	2	2	-	10	4	7	8	14	-
1966	6	4	-	8	7	5	6	8	-

(4) Net Profits (after Taxes) to Total Assets (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	H.S.E.	Praga	H.M.T.	Ex-cell-O
1956	4	5	(-)1	(-) 6	4	-	(-)17	0	-
1957	5	4	Neg.	2	2	-	-	1	-
1958	3	5	4	6	5	-	0	3	-
1959	4	5	13	5	6	-	4	4	-
1960	5	5	3	8	6	6	6	5	(-) 11
1961	6	4	2	9	5	6	(-) 2	8	(-) 7
1962	7	6	3	6	(-) 1	5	(-) 3	10	(-) 18
1963	5 (5)	7	(-)1	7	1	4	Neg.	11	8
1964	5	6	Neg.	9	1	3	2	11	10
1965	1	2	-	9	5	6	3	6	-
1966	4	3	-	6	7	3	2	3	-

(continued)

Table 4.3 : (continued)

(5) Earning (before Interest, Taxes and Managing Agents' Remuneration) to Net Sales (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	9	22	4	9	9	- (-)	30	7	-
1957	9	17	3	13	4	-	-	19	-
1958	8	16	13	14	7	-	6	21	-
1959	10	16	25	18	8	-	11	22	-
1960	11	16	11	20	7	12	20	22	(-) 277
1961	10	16	10	18	10	11	(-) 5	25	(-) 15
1962	16	14	15	16	2	11	(-) 5	29	3
1963	16 (15)	13	8	23	5	10	3	33	13
1964	15	12	11	25	5	10	10	33	13
1965	9	12	-	24	10	12	14	24	-
1966	12	13	-	14	16	14	15	18	-

(6) Dividends to Net Profits (after Taxes) (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	0	0	0	-	62	-	0	0	-
1957	80	0	0	96	85	-	-	0	-
1958	93	40	0	34	47	-	0	0	-
1959	64	42	0	48	44	-	0	0	-
1960	63	54	41	32	53	59	0	0	-
1961	63	57	20	35	41	58	0	72	0
1962	2	44	22	69	0	73	0	42	0
1963	2 (43)	71	0	35	149	73	0	36	0
1964	43	63	0	28	197	71	0	30	9
1965	7	167	-	27	55	40	50	26	-
1966	33	80	-	56	37	72	57	0	-

(continued)

Table 4.3 : (continued)

(7) Cost of Goods Sold to Net Sales (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	91	73	91	78	84	-	107	664	-
1957	89	78	90	75	79	-	-	137	-
1958	90	80	81	75	79	-	82	89	-
1959	89	78	70	68	80	-	77	82	-
1960	88	75	69	72	76	83	81	77	261
1961	88	75	67	67	78	82	86	83	106
1962	74	79	64	67	92	82	96	74	91
1963	76	80	70	69	88	83	89	70	83
	(75)								
1964	74	80	69	69	89	83	86	76	81
1965	80	81	-	73	87	82	76	72	-
1966	79	81	-	80	81	81	89	83	-

("Cost of goods sold" include consumption of materials and stores, fuels, other manufacturing expenses, wages and salaries, and depreciation.)

(8) Operating Expenses to Net Sales (Per cent)

Year	Batala	CISCO	Investa	Mysore Kirloskar	Cooper	N.S.E.	Praga	H.M.T.	Ex-cell-O
1956	4	10	15	17	11	-	18	73	-
1957	4	14	10	17	17	-	-	39	-
1958	4	11	11	15	14	-	18	19	-
1959	4	11	11	19	14	-	16	14	-
1960	4	14	24	16	14	7	13	14	164
1961	5	14	27	19	13	9	12	10	27
1962	11	12	31	20	15	10	14	7	14
1963	14	12	35	11	14	11	16	7	10
	(13)								
1964	14	13	34	11	12	10	16	8	10
1965	20	12	-	9	10	9	19	10	-
1966	16	12	-	10	8	11	21	14	-

("Operating expenses" include office expenses, interest, director's fees, royalties, insurance, etc.)

Source : Balance Sheets and Profit and Loss Statements of the Companies.

**Table 4.4 : Rank Correlation of Total Assets to Net Sales/
Total Assets, and to Net Profits/Total Assets
(Data for 1964)**

Sl. No.	Rank Total Assets		Rank Net Sales/ Total Assets		Rank Net Profits (after taxes)/ Total Assets	
	\underline{x}_1	(\underline{x}_1)	\underline{x}_2	(\underline{x}_2)	\underline{x}_3	(\underline{x}_3)
1. H.M.T.	1	(1)	7	(3)	1	(1)
2. Mysore Kirloskar	2	(2)	3	(1)	3	(2)
3. Cooper	3		2		8	
4. N.S.E.	4		5		6	
5. Praga	5	(3)	8	(4)	7	(4)
6. Investa	6	(4)	9	(5)	9	(5)
7. Ex-cell-'0	7		1		2	
8. Batala	8		4		5	
9. CISCO	9	(5)	6	(2)	4	(3)

(Figures in brackets show ranks of companies whose major portion of output is of machine tools.)

Thus, n = Number of observations = 9
(and) = (5) for companies having machine tools as the main line.

$$\Sigma D_1^2 = \Sigma (x_1 - x_2)^2 = 118$$

$$\Sigma (D_1^2) = \Sigma [(x_1) - (x_2)]^2 = (16)$$

$$\Sigma D_2^2 = \Sigma (x_1 - x_3)^2 = 102$$

$$\Sigma (D_2^2) = \Sigma [(x_1) - (x_3)]^2 = 6$$

Therefore, the Rank Correlation Coefficient = $1 - \frac{6 \Sigma D^2}{n(n^2-1)}$

$$r_{1.2} = 0.02$$

$$(r_{1.2}) = (0.20)$$

$$r_{1.3} = 0.15$$

$$(r_{1.3}) = (0.70)$$

Table 4.5 : Equity Share Data of Some Companies

	Year	Batala	Mysore Kirloskar	N.S.E.	Cooper
The face value of equity share (Rs.) (1963-1966)		10.00	100.00	100.00	100.00
Average market price of the equity share during the month in which the financial year of the company ends (Rs.)	1963	10.60	166.23	149.46	112.83
	1964	10.56	154.10	137.08	110.02
	1965	9.23	146.71	123.00	105.12
	1966	8.45	144.48	106.49	102.00
<u>Yield rate (per cent)</u>	1963	10.85	5.41	4.01	4.72
$\left[\frac{\text{Dividend per share}}{\text{Market price}} \times 100 \right]$	1964	8.42	7.64	5.46	5.30
	1965	0	7.25	5.96	7.92
	1966	5.92	6.92	7.53	11.58
<u>Earnings rate (per cent)</u>	1963	25.56	17.04	6.31	3.17
$\left[\frac{\text{Earnings per share}}{\text{Market price}} \times 100 \right]$	1964	19.88	31.92	8.62	2.61
	1965	5.20	32.53	17.97	14.55
	1966	18.46	24.61	11.48	31.16

Source : The Stock Exchange, Bombay. The Stock Exchange Official Directory.

CHAPTER 5PRICES AND MARKETING

In this chapter, the nature of the machine tool market, the channels through which sales are made, the setting of prices, the sales policies of major producers etc. are discussed, as the merits and demerits of the existing system have a close bearing on the future growth of the industry. In the balance of the chapter, is considered how the steps are taken to exclude foreign competition, and what are the prospects for finding export markets.

Diversity of Products

A detailed listing of the machine tools produced in the organised sector of the Machine Tool Industry, has been undertaken by the Indian Machine Tool Manufacturers' Association, Bombay 1. Upto 1964, only the information relating to the broad categories was collected. A more detailed listing of products has been commenced from the beginning of 1965.

The information relating to the year 1966 shows a wide variety of machine tools which are indigenously manufactured. They include automatic lathes, vertical turret lathes, drilling machines of different sizes, cylindrical, surface and tool and cutter, as well as plain double ended grinders, milling machines of various types, planing machines, presses and so on. The prices also vary widely depending upon the type and size of the machine. Thus, for example, a hydraulic open side

planing machine (2000 to 3000 mm stroke) is priced at Rs.1.87 lakhs, a planing machine belt drive (10' x 12') priced Rs.3.13 lakhs, a special-purpose machine priced at Rs. 1.50 lakhs, an electrically controlled horizontal milling machine (1600 x 355 mm) priced at Rs. 95,000, a vertical turret lathe (900 mm) priced at Rs. 3 lakhs. Also there are a bench drilling machine of Rs. 2,000, plain double ended grinder at Rs. 2,500, a bench lathe (250 mm swing) of Rs. 6,500, a horizontal milling machine at Rs. 28,000, a belt drive planing machine (4' x 8') at Rs. 17,000.¹

Because there is a diversity of products, and each product being technologically, at times, quite different from the other, it is difficult to make any generalizations regarding the cost-price structure, pricing policy, competition, or elasticity of demand. Every product, in a way, enjoys its own market, the degree of product differentiation being high.

Setting of Prices

Usual commercial procedures are followed regarding the setting of the price, at which the new product is to be launched into the market. On the advice of selling agents and with their help, prices and specifications for competitors' products are analysed and then the selling prices for the

¹ Data from the Indian Machine Tool Manufacturers' Association, Bombay 1.

products are determined in consultation with the selling agents, if the selling agency agreement calls for consultation in this matter. Generally, the advice of the selling agent is, however, sought. To ensure that the price so arrived at, does provide a reasonable margin to the firm, the studies are made in the Industrial Engineering Department to find out the breakeven point, at which the cost of the product equals the expected revenue from the sale. Steps are then taken to see that the production exceeds this point to ensure an adequate surplus.

There is no price control by the Government in the machine tool industry. In fact, such a policy would be hard to execute because of the diversity of products and peculiarities of cost structure associated with each. Some products may use more of imported components and items such as alloy steels, which go to increase the material cost. The products requiring the use of highly skilled labour incur high labour costs. If the product requires special tooling, the manufacturing overheads increase. It is thus difficult to make suitable groups of machine tools for which maximum ceiling prices can be determined.

Thus the price which is finally set for a product depends on a variety of factors, such as the overall demand for the product, the nature of the product, the competition from other manufacturers, the extent to which the product can be differentiated, etc.

The cost-price structure of the products of three firms is presented in Table 5.1 to obtain some pointers to know how the decisions regarding prices might have been arrived at.

The products 1 and 2 of the Firm A, and products 1, 2, 3 of the Firm B are simple types of lathes and drills. It is seen that profit margin on these items is not very high. The Firm B sells one of these products at a loss. The products 3 and 4 of the Firm A are a pillar drill and a radial drill of medium sizes, in the sale of which the Firm A has managed to make profits. The demand for both these products is adequate, the scope for product differentiation is large. Though the demand for the product 4 (a cutter and tool grinder) of the Firm B, is also adequate, the material cost of this item is high because 10 per cent of the components are imported.

The products 1, 2, 3 of the Firm C, are shaping machine of 24", 20" strokes capacity. The Firm faces competition from the products of other manufacturers, which produce not dissimilar types. In the case of products 5 and 6, both heavy duty planers, the Firm has set prices sufficiently high to make substantial profits on the sale of these machines. The demand for these machines is much more than the available supply. The product is manufactured in collaboration with a foreign firm of high repute. Only two firms are licensed to manufacture this product.

Table 5.1 : Cost-Price Structure of the Products of Three Firms (in the Year 1964-65)

	Firm A				Firm B											
	(1)	Perce- tage	(2)	Perce- tage	(3)	Perce- tage	(4)	Perce- tage	(1)	Perce- tage	(2)	Perce- tage	(3)	Perce- tage	(4)	Perce- tage
Raw materials	6,970	34	5,830	38	3,245	30	6,515	28	707	40	571	35	1,569	38	8,420	42
Direct labour	900	4	700	5	375	3	1,000	4	52	3	41	3	248	6	496	3
Outside processing	725	4	400	3	225	2	-	-	-	-	39	2	153	4	-	-
Overheads	7,400	36	5,780	37	3,140	29	8,320	36	851	48	770	46	1,122	27	6,564	34
	15,995	78	12,710	83	6,985	64	15,835	68	1,610	90	1,421	86	3,092	75	15,480	79
Selling agent's commission	3,040	15	2,270	14	1,590	15	3,390	15	200	11	210	13	620	15	2,860	15
Total Costs	19,035	93	14,980	97	8,575	79	19,225	83	1,810	102	1,631	99	3,712	90	18,340	94
Selling Price	20,700	100	15,530	100	10,875	100	23,250	100	1,785	100	1,655	100	4,120	100	19,500	100
Profit (or Loss)	1,625	7	550	3	2,300	21	4,025	17	25 (-)	2	24	1	408	10	1,160	6

	Firm C											
	(1)	Perce- tage	(2)	Perce- tage	(3)	Perce- tage	(4)	Perce- tage	(5)	Perce- tage	(6)	Perce- tage
Raw materials	5,465	43	9,006	34	12,235	39	4,302	31	79,953 ^{b/}	37	151,050 ^{c/}	50
Direct labour ^{a/}	1,122	9	1,649	6	2,114	7	1,189	8	4,425	2	5,367	2
Outside processing	-	-	-	-	-	-	-	-	-	-	-	-
Overheads	4,254	34	12,297	46	14,576	47	8,136	58	31,082	15	47,335	15
	10,841	86	22,952	86	28,925	93	13,627	97	115,460	54	203,752	67
Selling agent's commission	1,747	13	3,674	14	4,280	14	1,944	14	28,178	13	36,128	12
Total Costs	12,588	99	26,626	100	33,205	107	15,571	110	143,638	67	239,880	79
Selling Price	12,669	100	26,640	100	31,026	100	14,094	100	214,290	100	301,930	100
Profit (or Loss)	81	1	14	-	(-) 2,179	(-) 7	(-) 1,477	(-) 10	70,652	33	62,050	

a/ Includes outside processing. b/ 40% imported components. c/ 60% imported components

Products: Firm A : 1) Bench Lathe. (2) Geared head lathe. (3) Pillar Drill. (4) Radial Drill.
 Firm B : 1) Pillar type Drill Press. (2) Bench type Drill Press. (3) Plain type Drill Press. (4) Cutter and Tool Grinder.
 Firm C : 1) Shaping machine 24". (2) Shaping machine 20". (3) Shaping machine 24" (with some new design feature). (4) Slotting machine 16".
 5) Planer (Double Housing) 3 x 3 x 10. (6) Planer (Double Housing) 4 x 4 x 10.

Source : Data collected from the firms.

In the sale of the product 4, a slotting machine, the Firm C is not making much of a profit. Even though there is no competition for this product from other manufacturers, the user firms require only a few items, which once purchased, are not replaced for years. The demand is steady, but not overwhelming.

The cost of materials varies from product to product. In the case of products having a high content of imported components, the material cost is high, as in the case of planers manufactured by the Firm C. The labour cost is very low for all products as compared to the costs of materials and overheads.

Manufacturing overhead costs are allocated on the basis of machine-hours and assembly hours actually worked for each of the products. In the case of Firm A and Firm B, the administrative and commercial overheads allocated to each product, were 25 per cent of the price of the product. In the case of the Firm C, 70 per cent of the administrative and commercial overheads were allocated to the machine shop and 30 per cent to the assembly and were allocated to each product on the basis of actual machine hours and assembly hours worked per product.

Thus it is seen that the prices actually set depend mainly on the overall demand for the product and the nature of the product. In the case of simple machine tools, such as bench lathes, plain type drills, where a number of manufacturers are manufacturing similar products, the profit

margin to the manufacturer is low. If the manufacturer can effectively differentiate his product and if he enjoys a reputation for quality, he might have higher price than those of his competitors and still sell his product. In the case of medium size and heavy duty machine tools, however, the demand exceeded available supply, at least upto 1964-65. The number of manufacturers producing such products are limited, and the product can be effectively differentiated with modern design features. In such a case, the manufacturer enjoys a sellers' market. He may restrict his output, sell only a few items every year, charging a very high price per product.

Competition

The machine tool manufacturing in India is characterized by the diversity of products and a large number of firms specializing in certain items. The Table 5.2 gives the classification of manufacturers according to the types of products they manufacture. It is seen that apart from cone-pulley lathes, geared head lathes, shaping machines, drilling machines (Pillar type), in the case of most other products, the number of manufacturers very rarely exceeds three. For many types of milling machines, some types of lathes, presses, hammers, planers, there is only one manufacturer manufacturing each type.

Because of the tendency of manufacturers to specialize and differentiate their products, effective competition among the products is rarely felt. If, in addition, the firm is able to control the market through effective marketing

Table 5.2 : The Productwise Classification of Manufacturers

Type of the product	No. of Manufacturers
1. Automatic (Single Spindle bar)	3
2. Boring Machines	
(i) Fine	2
(ii) Horizontal Table type	2
3. Drilling	
(i) Bench type	3
(ii) Multi-Spindle type	3
(iii) Pillar type	9
(iv) Radial	5
4. Gear-Cutting, Hobbing-Shaping	3
5. Lapping (Centre)	1
6. Capstans	4
7. Turrets	5
8. Lathes	
(i) Cone-pulley	13
(ii) Copying	1
(iii) General purpose - Geared Head	7
(iv) High precision type	1
(v) Metal Spinning	1
(vi) Production with preselect head	1
(vii) Second operation	1
9. Milling Machines	
(i) Automatic - electrically controlled	1
(ii) Bed type	1

(continued)

Table 5.2 : (continued)

Type of the product	No. of Manufacturers
9. Milling Machines (contd.)	
(iii) Duplex	1
(iv) Plain, Universal and Vertical	6
(v) Plano type	1
(vi) Keyway type	1
(vii) Slot type	1
(viii) Ram Turret type	1
10. Presses	
(i) Hand-fly	1
(ii) Hydraulic open throat type	1
(iii) Mechanical power	5
(iv) Trimming	1
(v) Pneumatic	1
(vi) Rubber moulding - upstroking type	1
(vii) Press brakes - mechanical power	3
11. Sawing	
(i) Band-saws	2
(ii) Hacksaw	4
12. Shaping Machines	11
13. Shearing Plate and Sheet Metal	
(i) Alligator type	1
(ii) Treadle type	1
(iii) Guillotin type	4
14. Slotting Machine	1
(continued)	

Table 5.2 : (continued)

Type of the product	No. of Manufacturers
15. Screwing	1
16. Hammers	
(i) Chipping type portable	1
(ii) Drop-stamp	1
(iii) Pneumatic type	1
17. Tapping	2
18. Bending	2
19. Polishing	1
20. Planing	
(i) Belt drive	5
(ii) Electric double housing	2
(iii) Open side hydraulic	1
21. Grinding	
(i) Carbide tool type	3
(ii) Centreless type	1
(iii) Cylindrical hydraulic type	2
(iv) Plain type	2
(v) Plano type	1
(vi) Snagging type	2
(vii) Surface type	4
(viii) Swing frame type	2
(ix) Tool and outter type	2
22. Special purpose machinery	3

Source: Indian Machine Tool Manufacturers' Association,
Bombay: Directory of Indian Machine Tool
Manufacturers, 1960, pp. 6-20.

arrangements, the monopolistic position of the manufacturer is made doubly secure. Machine tool manufacturers sell to knowledgeable customers. They sometimes have their own means of servicing their purchasers, and where this is not the case, the expert servicing by their agents is done. Thus even if there are other manufacturers producing similar products, a firm, differentiating its product to the possible extent and making effective marketing arrangements to sell it, can establish its position in the market securely.

The market positions, once built up, are difficult to dislodge. Such a market position, based ultimately upon differentiation of, and specialisation in, products ensures that one possible strategy of other manufacturers i.e., price-cutting, is relatively ineffective. The more standardized the product, the more useful--and dangerous--is price as a competitive weapon. (It is also true that the control of market based on product differentiation and specialisation, reduces the prospect of a wider adoption of the principle of unit construction and standardization, and consequent lowering of the costs.) In the absence of standardisation, other manufacturers cannot effectively compete by lowering the prices of their products.¹

¹ This is also true of industrially advanced countries such as U.S.A., where the number of manufacturers producing a particular item not technologically dissimilar (though each one introducing some special design features to differentiate one's product) is much greater than that in India. "Competition through price-cutting has rarely troubled this (machine tool) industry. It is significant that a search through

(continued on next page)

For simple types of machine tools, viz., bench lathes, simple drills and grinders, the number of manufacturers is quite large and the possibility of differentiating the product effectively within a price-range for which the product can be marketed, is limited. Thus, the competition is keen. Also there is evidence of some competition for these types, from the products manufactured by the machine tool builders in the unorganized small-scale sector, especially those in Punjab. A small workshop owner prefers to buy, for example, an ungraded bench lathe upto 250 mm swing capacity costing about Rs. 2000, from a small scale manufacturer in Punjab than a graded one, costing about Rs. 4000 to Rs. 6000 from the manufacturer in the organized sector. Admittedly, a Punjab lathe is cruder in design, less sophisticated and inferior in quality when compared to a graded lathe the equivalent capacity; but a small workshop owner with limited funds for investment is less inclined to care much for precision and durability. Nevertheless, the

(Footnote from last page continued)

text-books on American monopoly history and policy has failed to disclose a single case where government action was taken against a machine tool maker. This inaction may conceivably be due to the equivocal attitude of antitrust laws to the user of patent rights, but it was more likely to have been due to the fact that price is not a competitive weapon, which could be used by itself with much success in the machine tool industry." Quoted from M. E. Beesley and G. W. Troup: "The Machine Tool Industry," The Structure of British Industry, ed. Duncan Burns, National Institute of Economic and Social Research, Cambridge University Press, 1958; Vol. I, p. 377.

market within which the unorganized sector can compete with the organized sector is a narrow one, limited only to the small workshops mostly. In addition, small-scale manufacturers in the unorganized sector have not yet built machine tools of medium size and heavy duty types. At present, the two sectors, the organized and unorganized ones, seem to operate in rather two distinct markets for all practical purposes, the organized sector catering to the demands of medium and large scale industries.

During the last several years, the established manufacturers enjoyed sellers' market. Only in recent two or three years, the manufacturers are finding it hard to sell their products due to recessionary tendencies,¹ but there is little evidence to show that, where there are a number of manufacturers producing a particular product, the competitive weapon of price cutting has been resorted to by any producer to increase the sales of his product. Only a prospectively very large increase of standard machine tools would induce the firms to alter fundamentally the present market positions, but such a standardization is unlikely to take place in the case of machine tools. Thus, only the changes in the marketing arrangements can lead to greater competitive efforts. The chief benefits of the increased competition would be felt, however, not in the form of lower prices, but

¹ The current recession and its impact on machine tool industry in India is discussed in Chapter 9.

in quickening tempo of technical application to customers' requirements. Certain changes in the present marketing arrangements, especially those regarding the system of sole selling agency, are suggested later on, following the description of channels of distribution of machine tools.

Channels of Distribution

The distribution of machine tools from the factory to the final customer can be said to follow three main channels:

- (a) Sales to the government,
- (b) Direct sales to large customers,
- (c) Sales to the distributors.

(a) The government has the first call on the supplies of factories and it takes about 40 per cent of the total output every year. The percentage of government purchases differs from firm to firm. During the year 1963-64, the Government of India, the State Governments, and the Government Corporations together placed orders for about 60 per cent of HMT's total output during that year. On the other hand, in the case of other large firms studied, and most of the firms answering the mailed questionnaire, the Government orders amounted to about 20 to 40 per cent of their output. A case was observed where the firm sold 80 per cent of its output to the Government.

The Director General of Supplies and Disposals of the Central Government asks for public bids giving the requirements of sizes and types and afterwards allocates to the

factory the quota required by the concerned departments of the Government. During the three years from 1959 through 1960-61, the D.G.S. and D. placed orders for machine tools valued at Rs. 9.39 lakhs approximately (i.e., 54 per cent of the production of graded machine tools during those years). The typewise composition of the purchases by D.G.S. and D. is as follows.

Table 5.3 : Value of Orders Placed during 1958-59, 1959-60 and 1960-61 by the D.G.S. and D.

Type of Machine Tools	Total for the three years Value Rs. in thousands	Percentage to the total
Lathes	60,472	64.40
Milling	13,768	14.66
Drilling	3,538	3.77
Shaping and Planing	5,839	5.81
Grinding	762	0.81
Boring	127	0.14
Others	9,380	10.41
Total	93,866	100.00

(Total machine tools exclude blowing, coil cutting, edging, polishing, chamfering, die-casting, nibbling machines and other miscellaneous metal forming machine tools.)

Source : Government of India, Indian Annuals Bureau: Supplies and Disposals Yearbook, 1961-62, New Delhi.

Differing attitudes regarding the requisitioning by the Government of the bulk of the annual output of the firms ranges from absolute thankfulness to that of bitter criticism. To the manufacturers of extremely sophisticated, special purpose types for which there is little popular demand, or to the ones manufacturing simple types of bench lathes or drills, for which there is keen competition, the orders from the government are a salvation. Without such assured consumption of more than half their output, these firms would be out of business.

By contrast, a few large firms of types for which there was a shortage of supply (e.g. capstan, turret lathes, radial drills) fretted at having to sell more than one-third of their output for appreciably less amount than they could get for it in the open market. The prices offered by the government are mostly 3 to 5 per cent less than those in the open market; but even if the prices in the open market are equal to those offered by the government (as they sometimes are), by the very nature of the contract, the machine tool manufacturer is obliged to sell his output for a fixed period ranging from an year to an year and a half to the government at predetermined prices. Thus, if during this period, the prices in the open market rise higher, the machine tool manufacturer is unable to take advantage of this increase in prices. This disadvantage is compensated somewhat by the security, that the manufacturer gets from the steady official

requisitions. This amount of security is especially important in view of the traditional uncertainties of the machine tool demand.

(b) Customers other than the Government to whom direct sales are made, are mostly other big firms using machine tools, with whom each machine tool firm deals individually. Sales of this sort make up a relatively small proportion of the total output in the case of most firms (a firm such as Ex-Cello is an exception, which produces high specialised equipment only tailored to the orders of the individual customers), since the firms prefer to deal through the distributors. HMT, which has its own sales organization, sells about 40 per cent of its output to direct customers.

(c) The usual channel widely used by the machine tool firms to market their products is sales through their distributors. Seven firms studied, and 19 out of the 21 firms, which answered the mailed questionnaire, were marketing their products through the selling agents. These distributors have long standing relationships with their suppliers. The firm rarely gives all the products to the single distributor. The general practice seems to be to give different products to the different distributors. Normally, the distributor gets the sole agency for the products which he sells. The agency may be for the whole of the country, if the distributor has competent branch offices at the important centres. The commission given to the distributors is about 15 to 20 per

cent of the sales price of the product. The products that are marketed through the distributors are mainly 'standard products' which are regularly manufactured and are shown in the catalogues. The 'job products' are manufactured against specific orders and to the requirements of the customers. They are sold by the firms themselves.

The Machine Tool Marketing Practices
in the Great Britain and U.S.A. in
Comparison with Those in India

In this connection, it is useful to compare the marketing practices in India with those in Great Britain and U.S.A.¹

In Great Britain, there are a small number of marketing organizations or what are called 'leading agents' like the Associated British Machine Tool Makers (A.B.M.T.M.). The A.B.M.T.M. deals with practically whole of the products of its constituent members. Similarly, there are other independent leading agents, who dominate the market. The marketing practice is based on the system of sole agency. The agency once granted, changes hands infrequently. Each leading agent attempts to represent a whole range of specialist manufacture. The system of leading agents affects the rivalry between established manufacturers. The situation is very serious for a new entrant with innovations or wishing to expand his sales

¹ The discussion regarding marketing practices in Great Britain and U.S.A. is based on the description in the article by Beasley and Troup: "The Machine Tool Industry," The Structure of British Industry, Vol. 1, op.cit., pp. 381-386.

through innovations. An agency with the leading agent is the most valuable asset and has favourable effects upon a firm's prospects of growth, but there are a few agents to choose from. For new untried products, as many outlets must be possible, thus it is argued that the effect of the sole agency system oppressively limits the speed of development of sales for new firms. A new machine tool, once it is ranked in the sole selling organization along side many other products, may not be pushed as vigorously as it would be, if more agents were appointed.

On the contrary, the exclusive agency is a doubtful legality in U.S.A. It is certainly difficult to uphold it in a court of law. Instead of the system of sole agents, in America the system of jobber of machine tools prevails. The jobber firm specializes in the marketing of certain classes of machine tools. A firm dissatisfied with its first agent can appoint others without difficulty. It can also appoint more than one jobbers. Jobbers, among themselves, face intense competition. This, on the whole, gives the machine tool producing firms, especially for new entrants, a greater chance of expanding the sales, establishing themselves and growing, than their counterparts in Great Britain.

Some features in the British marketing practices and the Indian ones may be noted. Though the Indian machine tool firms have not built themselves into a compact marketing group as the A.B.M.T.M., a few selling agents dominate the

Indian market. The practice of the sole selling agency is common to both the British and Indian marketing structure. The selling agency, once granted, seldom changes hands. Thus defects in the British system e.g., the restraint on effective product competition, the restraints on the development of sales of a new product, are also present, by and large, in the Indian system. A system on the lines of jobbers in U.S.A. would be more desirable if the product competition is to be encouraged.

Customer-Manufacturer Relationship

In the case of machine tools, generally there appears to be a certain gulf between the requirements of the users and the machine tools supplied by the manufacturers. This is especially so when the pace of technological change is rapid. Thus the machine tools of a particular design suitable for one type of product do not appear appropriate for the sophisticated variety of the same product. The technique changes. The pattern of industrywise demand changes and the machine tools suitable for a railway workshop are not required in the automobile plants. Thus, continuous developments and innovations in machine tool design are needed to suit the requirements of the customers. This points out to a need for a much earlier continuing consultations of appropriateness and economy, entering the design planning from the start. Experimental and development work in machine tools, which is concentrated in the manufacturing firms, tends to be

directed towards the existing range of tools rather than aimed to deal with the problems arising from users' needs and plans. Because of this inherent difficulty in keeping pace with the users' requirements, the firms in industrially advanced countries at times tend to bypass the selling agents and reach out to the customers themselves. This is more true in United States than in Great Britain. To quote from the article by Beasley and Troup, " The American machine-tool manufacturers believe in direct selling; that they not only make it their business to keep themselves informed of potential customers' investment plans, but would, if possible, be in there, making the plans with them; and that they will not only have their representatives at the customers' works, but will also make sure that their own sub-contractors would be there to assist the deliberations, to make modifications and to give suggestions." ¹

The position in Indian market for machine tool is somewhat different. Shri M.V.S. Naidu, the District Sales Manager, Bombay, HMT, brings out the difference between the buyers in the Indian machine tool market and those in industrially advanced countries. "In the industrially advanced countries, consumers ably discriminate between different makes of the same machine tool on the basis of engineering economics and marketing can be promoted through effective technical comparisons between the different makes. The manufacturing firms

1 The Structure of British Industry, op.cit., p. 387.

of these machine tools also anticipate and implement consumer preferences and exact requirements as dictated by their marketing organizations, established as such by direct personal contacts with the consumer and the study of competitive makes. In the Indian market, on the other hand, with the infant industry, only a few machine tool factories are producing the internationally accepted quality of machines either with foreign collaborations or through copying old designs. With the current foreign exchange shortage and limited indigenous production, the market can offer very limited choice or none at all to a consumers." Thus, in effect, a sellers' market is created, in which the machine tool builders and marketing organizations depend "less on increasing the technical consciousness of the buyer than on the exigencies of the demand and supply position." ¹

Shri Naidu accuses both the manufacturers and selling agents in severe terms. It would be difficult to find the exact data to substantiate these allegations. Nevertheless, the talks with officials of the firms and the marketing organizations point out that there may be an amount of truth in these allegations. Though there are certain attempts to reach out to the customers, not much systematization in these efforts is seen.

¹ M.V.S. Naidu, "Scientific Marketing of Machine Tools Needed," Machine Tool Engineer, Vol. V, No. 2, Hindustan Machine Tools, Bangalore: January-March 1964, pp. 12-13.

The marketing efforts of the firms are at present meagre. With the exception of HMT whose expenses on advertising and publicity were of the order of Rs. 3,92,000 in 1963-64, the other firms spend considerably less. Such advertising as it takes place is mostly in technical journals and sometimes in other newspapers. Catalogues of items manufactured, with the technical descriptions of the products are published, but no efforts are made to send these out to the potential customers. Six firms studied and twelve out of twentyone answering mailed questionnaire, issued maintenance manuals, detailed spare parts lists, tables and charts. Most of the firms, as well as the selling agencies employ sales engineers, but the arrangements for providing servicing facilities seem to be scanty. Only five of the 21 firms answering the mailed questionnaire and five firms studied, had any such arrangements for servicing facilities.

Market research is another field to which very little attention is paid by the firms, partly because it is beyond the scope of the meagre resources of an individual firm to sustain a continuous research programme, and partly it is due to the habit of the firms to depend on the advice of their selling agents regarding the market acceptance of a new product or increase in the sales of an established product. Selling agents collect the data from the branch offices and sales engineers, but no elaborate market surveys sustained over a period of time were undertaken by them. The National Council of Applied Economic Research has in 1965 published a

study of demand of machine tools during the Fourth Five Year Plan. But, as far as the pointers to the shifts in the demand in the short run are considered, the machine tool builder has no signals available and must depend on the educated hunch and other scanty data available. Upto 1964, even the data regarding the detailed type and sizewise analysis of production was not available. The Indian Machine Tool Manufacturers' Association has started collecting such data from 1965 onwards. Monthly or quarterly statements of production are sent to the members of the Association.

Thus tools available for the manufacturer to establish liaison with the customers are sparingly used. The Indian system of sole agency is also inadequate for such a close liaison. Though the system does leave open to the firm the option of direct contact with the customers, generally the lines of communication between the customer and the manufacturing plant are lengthened by the selling structures; and the selling agency itself representing many different classes of tools, the very economy in the centralized representation is at odds with the pressures towards elaborate and continued consultation and willingness to modify a particular product.

Exclusion of Foreign Competition

It has already been noted that Indian machine tool manufacturers, for a number of years enjoyed the sellers' market. Their position was made stronger by the steps taken up by the government to exclude the competition from abroad.

Before the Second World War, the country depended on imported machine tools, of which the bulk came from Great Britain. There was virtually no indigenous production. Though the industry had a period of rapid growth during the Second World War period due to the difficulty of getting imported machine tools, as well as due to measures adopted by the Machine Tool Controller, the situation changed after the War. There was heavy influx of surplus war-produced machinery from U.S.A., Great Britain and other belligerent countries, which almost crushed the newly developing indigenous machine tool industry. The indigenous production continued to decrease after 1945 and it was at its lowest in 1950.

The Machine Tool Panel considered the problem of protection to the indigenous manufacturers.¹ The Panel felt the difficulties of giving protection in the case of machine tools. The machine tools were manufactured under different conditions in different regions and the cost of production differed from place to place. The Tariff Board can lay down, after taking into consideration all aspects of the problem, an average rate of protection for the industry as a whole. The result would be that some of the machine tools may get more protection than they needed, while others would not be able to cover the extra cost of production. If

¹ The Report of the Machine Tool Panel, 1949, op.cit., pp. 12-19.

on the other hand, the tariffs are unduly raised, the interests of the consumers would suffer, the total industrialization of the country would suffer and the industry itself would lose the incentive to progress, which could come through a struggle for existence.

Thus the Panel recommended:

- (a) a general average increase in the tariff on the imported machine tools to the extent found necessary by the Tariff Board, and
- (b) an adequate price preference through the Machine Tool Development Officer for those indigenous machine tools for which the increase in tariff has not afforded adequate protection.

Certain other steps have been taken since 1951 to protect the indigenous manufacturers against the foreign competition. All the applications for imports are to be made to the Chief Controller of Imports and Exports, New Delhi, or to the Development Officer (Tools) in the Directorate General of Technical Development, in respect of items of machine tools valued below Rs. 1 lakh, who determines whether the licence to import the particular machine tool is to be given.¹ According to the Import Trade Control Policy, the licence to import a particular machine tool is given, if that type of machine tool cannot be supplied by the indigenous

1 Procedures for Industrial Licensing, op.cit., p. 17.

manufacturer. Thus, the imports of such items are totally banned, as can be manufactured in India. The schedule of machine tools, the imports of which are banned, is published every year in the annual volumes of The Import Trade Control Policy published by the Government of India. The list of banned machine tools in 1965 included items such as cone-pulley lathes, all gear-head lathes upto 13" height of centre, bench lathes, double ended pedestal type grinders upto 24" diameter, universal and cylindrical type grinders upto 350 mm., surface grinders hand operated type, bench drilling machines, pillar drilling machines upto 2" diameter, single and double ended boring machines unit head type, shaping machines of all sizes, slotting machines upto 16" stroke, planing machines upto 5' x 5' x 20', hacksaw machines upto 12" capacity, simple types of presses and sheet metal machinery, and also chucks, machine vices, drill sleeves, live centres of various sizes, etc.

Instead of the protective tariff, a revenue duty is imposed on all the types. The changes in the rates of revenue duty during the last 26 years are shown in Table 5.4.

According to the Finance Act 1965, a regulatory duty of customs is imposed, not exceeding: (a) 25 per cent of the rate, if any, or (b) 10 per cent of the value of goods, whichever is higher.¹

¹ Indian Customs and Central Excise Tariffs, April 1965, op. cit., p. 1.

Table 5.4 : The Customs Duty on Machine Tools

Year	Nature of duty	Standard rate of duty
1940	Revenue	10 per cent ad valorem
1945	"	10 " " "
1950	"	10½ " " "
1955	"	10½ " " "
1960	"	10 " " "
1961	"	15 " " "
1962	"	15 " " "
1963	"	20 " " "
1964	"	20 " " "
1965	"	20 " " "
1966	"	40 " " "

Source: Government of India, Department of Commercial Intelligence and Statistics, Calcutta: Indian Customs and Tariffs, Volumes from 1940 to 1964 and Indian Customs and Central Excise Tariffs Vol. 1, Customs Tariff Only (Volumes for April 1965 and June 1966).

The rate of revenue duty is increasing in recent years. In addition to the revenue duty, the charges such as sea freight, insurance, loading on duty, clearance etc. are to be added to the net f.o.b. price of the imported item. Thus the price of the imported machine tool after adding all these charges and customs duty, the selling agent's commission

is inflated to almost twice its original f.o.b. price.¹

It has been commonly alleged that the prices of indigenous machine tools are higher than f.o.b. prices of imported ones, comparable in type, size, design and quality.² Because of the variety of types and sizes of machine tools, it is difficult without detailed data to investigate whether such is really the case. The prices of the imported machine tools also differ according to the country of their origin. It is suggested that prices of machine tools imported from

1 The rough calculations, as provided by an official of a selling agency at Bombay, are as follows:

	Rs.
Manufacturer's f.o.b. price, say,	1,000
Less : Discount, if any, 5 per cent	<u>50</u>
	950
Add extras 2 per cent	<u>20</u>
Net f.o.b. price	970
Sea freight charges 10% (on mfg. f.o.b. price)	100
Insurance 1% (" " " ")	<u>10</u>
Net c.i.f.	1,080
Customs duty 40% { " " " " }	400
Regulatory duty 10% { " " " " }	100
Loading on duty 10% { of the duty }	50
Clearance 3% { on mfg. f.o.b. price }	<u>30</u>
Net Landed Cost	1,660
Selling agent's profit margin 20%	<u>332</u>
Selling agent's price	1,992

2 Interviews with the officials of the firm, the Secretary of the Indian Machine Tool Manufacturers' Association and other knowledgeable persons in the industry. Nevertheless, such an allegation is not found in any of the government reports, or the publications of the Association, or any other articles by others, with sufficient evidence to prove it.

U.S.S.R., are less than those from U.S.A. or U.K.¹

Export Markets for Indian Machine Tools

While the Indian machine tools began to be exported more than ten years ago, it was on a very small scale. Even though the quantity of exports has been increasing in absolute terms over the years the proportion of exports to the indigenous production is a very small one.

The insignificant role of India as an exporter of machine tools can be seen from the Table 1.4 in Chapter 1 where the achievement of some of the 28 countries (industrially developed and developing) of the world for the year 1965 in the field of production and trade is given. Although India ranks 11th in her production of machine tools, she ranks very low, 21st as far as exports of machine tools are concerned, with exports forming only 1.5 per cent of indigenous production.

Exports of Indian machine tools were directed not only to the developing countries in Africa and Asia, but also to developed countries in West Europe, East Europe and North

1 Seymour Melman: The Peace Race, Victor Gollas Ltd., London; 1962, p. 45. Melman estimates that as of 1961, a dollar available for capital expenditure will buy twice as much Soviet produced machine tools of the same types as the United States produced equipment. This difference is ascribed to the application of mass production methods in U.S.S.R. as opposed to the batch production method in U.S.A. Similarly, the Soviet Bloc uses dumping practices to sell the equipment to under-developed countries.

America. The Table 5.5 gives important destinations to which exports were directed in 1965-66.

Table 5.5 : Important Destinations to which Exports of Indian Machine Tools were Directed during 1965-66

Destination	(In thousand Rs.) Exports
Czechoslovakia	1,322.9
Poland	333.8
Nigeria	289.2
South Vietnam	214.0
U. S. A.	192.6
Malaysia	135.4
West Germany	114.3
New Zealand	108.9
Iran	83.8
Australia	38.9
Canada	25.0
U. K.	16.7
Ceylon	14.9
Total (including others)	3,560.0

Source : Government of India, Department of Commercial Intelligence and Statistics, Calcutta: Monthly Statistics of the Foreign Trade of India - Exports and Re-exports, March 1966.

The demand for machine tools in the overseas markets continues to be vast both in the developed and developing countries. It is seen from the Table 1.4 in Chapter 1 that even many of the highly developed countries are importing machine tools over 10 per cent of their requirements. Market studies have shown that these countries prefer to import comparatively labour-intensive items like simple machine tools as a result of rising cost of their labour.¹ Similarly the Trade Delegation to Latin America and U.S.A. indicated the export possibilities of machine tools and small tools to these countries.² Some developing countries too, like Iran and Iraq, are promising markets for Indian machine tools. The Seminar on the Exports of Machine Tools, however, came to the conclusion that bulk of export markets would be in developed countries, particularly U.S.A., Canada, Australia and New Zealand.³

The Strategy for Export Promotion

The export of machine tools to foreign countries especially to the industrially advanced countries is a difficult

1 Engineering Export Promotion Council: Report of the Trade Delegation to West Asian and European Countries, Calcutta: 1961, p. 26.

2 Engineering Export Promotion Council: Report of the Trade Delegation to Latin America and U. S. A., Calcutta: 1962.

3 Indian Institute of Foreign Trade : Conclusions and Recommendations of Seminar on Exports of Machine Tools. Calcutta: February 1967, p. 22.

task and special efforts need to be directed to promote exports. The strategy consists of getting knowledge of export markets, their potentiality and special needs etc. If one can afford, it is best to set up initially small contact offices in prospective areas, and aided by local market agencies, carry out demand studies before trying to establish elaborate sales arrangements.

The appointment of local dealers causes difficulties. Normally, dealers of repute have already in their coverage all well-known manufacturers of machine tools either of the country or abroad. Hence, it is unlikely that they would give up established representations and entertain conflicting interests. Hence, an Indian manufacturer has to entrust his business to comparatively new business houses. The Seminar on Export of Machine Tools recommended that the Ministry of Commerce of the Government of India may use the good offices of India's Trade Representatives abroad to help for the appointment of agents for Indian manufacturers.¹

Another method of promoting exports through foreign collaborations can be used. As most of the Indian machine tool manufacturers are having technical collaboration arrangements with manufacturers in developed countries, possibility exists for exports of components and basic machines to the collaborators' factory and also of such other

1. Ibid, p. 34.

components which would be economically manufactured in India. This has already been tried out satisfactorily by quite a few exporters in India as an avenue for increasing the export of machine tools.¹

The demand for Indian machine tools in developing countries is comparatively smaller. By and large, as these developing countries are short of foreign exchange, one of the ways of entering into these markets is by way of tied Government loans, the Ministry of Commerce ensuring that these loans were utilized for the import of Indian engineering products. It was suggested in the Seminar on Exports of Machine Tools that gifts of complete workshops to some of these developing countries would be more than repaid by substantial orders in the years to come. The initial gift of a machine tool workshop comprising a variety of machine tools would be an introduction of the product into that country and act as a forerunner for future orders.²

The setting up of facilities for adequate servicing and provision of spare parts is essential to promote exports. The manufacturer can send his own representatives to work with distributors and service the machines and visit potential customers. Opening offices and show-rooms abroad is desirable. The HMT has already opened an office in New York

1 Ibid, p. 35.

2 Ibid, p. 36.

and Frankfurt and proposes to open an office in Chicago, but such a practice is well beyond the resources of a large number of manufacturers. Building up of a good image of Indian machine tool manufacturing facilities and the products by inviting foreign importers and dealers to India, and also by means of external publicity, would help.

Marketing research plays a significant role in the promotion of exports of machine tools, which are relatively new trading items. Instead of individual manufacturers undertaking market surveys, the task which may be beyond their individual resources, the services of organisations like Indian Institute of Foreign Trade, Engineering Export Promotion Council or Indian Machine Tool Manufacturers' Association can be used.

The Government Policies to Promote Exports of Machine Tools¹

In their efforts to promote exports of machine tools, the manufacturers have been well assisted by the Government of India. Exporters enjoy considerable concessions and incentives. Fabricators of engineering products get supplies of steel at prices based on the London Metal Bulletin

1 The description of the Government policies is from:

(a) S. M. Patil: "The Indian Machine Tool Industry and Its Export Potential," Machine Tool Engineer, Vol. VIII, No. 4, October-December 1967, p. 11.

(b) Conclusions and Recommendations of Seminar on Exports of Machine Tools, pp. 43-44.

quotations. Another measure that benefits manufacturers that they get import licences to the extent of their actual import content. This ensures the availability of imported raw materials, stores and components. The exporters of machine tools get cash subsidy of 20 per cent of the f.o.b. value. Moreover, exporting industries have been given a special facility for the import of balancing equipment and capital goods which are expected to improve the competitive ability of the exporters.

The other facilities are: the full amount of excise and import duties on raw materials and stores, which go into the manufacture of items exported, are refunded by way of drawback; exporting industries are given a liberal treatment in the issuance of foreign exchange sanction for visits abroad, in the opening of foreign offices and in the import of samples. The Reserve Bank of India has given concessions by way of credits and deferred payments at low interest rates. The Reserve Bank has agreed to allow credit upto seven years, and bankers are permitted to advance finance to exporters of engineering products at 6 per cent. In turn, they will get reimbursement from the Industrial Development Bank of India (IDBI). Under the scheme operated by the Engineering Export Promotion Council, exporters get assistance upto 33 1/3 per cent of the total cost of publicity overseas.

The Seminar notes certain deficiencies of the Government policies, but such grievances are directed mostly towards

the operation of the various schemes, such as the difficulties in getting approval of the export credit or the need for more extended credit etc.¹

The Indian Machine Tool Manufacturers' Association is trying to promote a consortium of machine tool manufacturers for setting up export houses abroad. The export houses were expected to take up the representation of the manufacturers who join the consortium and offer all types of services for finding out markets for machine tools and conducting their sales abroad.²

The industry and the Government agree on the need for promoting the exports of machine tools. Manufacturers, who are facing slump conditions at home, may be relieved to find export markets abroad. The spurt in the export of machine tools during 1966 indicates somewhat serious attempts on the part of manufacturers in this direction. The Government has also assisted them in their efforts. Basic to all considerations, however, is the quality of the Indian machine tools in view of competition from similar products manufactured in advanced countries. The improvement in the quality of indigenous products depends on the quality of raw materials, as well as on the skills of machine tool labour force, and the

1 Conclusions and Recommendations of Seminar on Exports of Machine Tools, op.cit., p. 43.

2 Indian Machine Tool Manufacturers' Association, Bombay: Annual Report 1966-67.

effectiveness of supervisory and managerial personnel in utilizing these skills. The appraisal of these human resources engaged in the manufacture of Indian machine tools forms the subject matter of the next chapter.

CHAPTER 6HUMAN RESOURCESLabour Force

In all under-developed countries, the problem of transformation of labour force with its agricultural origins and attitudes, low levels of literacy into a competent industrial labour force is an important one, which is an important single factor likely to decide the pace of industrial development. Many changes in the state of labour force have taken place during the last two decades. The Government/^{and manufacturers have} ~~may~~ become aware of the problems of training the skilled labour force. The labour legislation for workers has gone a long way towards easing the life of workers. The implications of these changes for the labour force in the machine tool industry are considered below following the discussion regarding the nature and composition, the absenteeism and turnover, productivity of the machine tool factory worker.¹

¹ The discussion of the labour force in machine tool factories in this chapter depends partly on the data collected from the firms studied and answers to the mailed questionnaires from the machine tool firms during 1964-65. To supplement this information, data from the following publications is used wherever relevant, to present a picture of the whole industry.

(1) The Government of India, Ministry of Labour and Employment, Labour Bureau: Report on Survey of Labour Conditions in Machine Tool Factories in India. New Delhi, 1965. (referred to as 'Bureau Report' in this chapter).

(continued)

Nature and Composition of the Labour
Force in Machine Tool Factories

The average daily employment in 590 machine tool factories (both large and small) was 31,000 in 1963. As an indication of the swift-rate of growth of this industry it may be noted that in 1957, in the total 232 factories, the average daily employment was 11,000. Thus within a space of six years from 1957 to 1963 the number of factories increased by 358 and the average daily employment increased by 20,000.¹

Recent data regarding the classification of machine tool factories into large and small ones, is not available. The Labour Bureau Report, accepting the stratification point used for the Wage Census (conducted by the Bureau in 1958-59) has treated all machine tool factories employing 25 or more

(Footnote from last page continued)

In order to assess the impact of various measures on the industrial labour force and to appraise their present conditions, a scheme of comprehensive surveys of labour conditions in various industries was incorporated in the Second Five Year Plan. The Bureau Report on the Machine Tool Industry covers a frame of 275 factories (78 large and 197 small ones). The sample consists of 22 large factories and 26 small factories, with employment of 2,803 and 357 workers respectively. Thus 28.2 per cent large factories and 13.2 per cent small factories are covered. The survey was conducted during 1960-61 and refers to the data mostly of 1959-60 and 1960-61.

(ii) Other reports, books and articles acknowledged at the relevant places in the course of the discussion.

¹ The Government of India, Ministry of Labour and Employment, Labour Bureau: Indian Labour Statistics 1963, New Delhi, p. 26. The number of factories includes both large and small scale factories registered under the Factories Act, 1948.

workers as large establishments and the rest as small. Thus in 1958, there were, according to the Bureau Report, 78 large factories employing 3,241 workers and 197 small factories employing 2,734 workers, the total being 275 factories employing 10,975 workers.¹ Thus, out of the total employed workers in the machine tool industry, 75 per cent were in the large factories.

The Table 6.1 gives the estimated total number of employees by broad occupational groups in the machine tool industry, as on 31st December 1959.

Table 6.1 :

Size	Total working force as on 31-12-1959	Technical and related personnel	Executive and Managerial personnel	Clerical and related personnel (including Supervisory)	Production and other workers	Watch and Ward etc.
Large factories	9,218 (100.0)	405 (4.4)	124 (1.3)	688 (7.5)	7,351 (79.8)	650 (7.0)
Small factories	3,199 (100.0)	41 (1.3)	14 (0.4)	117 (3.7)	2,952 (92.3)	75 (2.3)
All Factories	12,417 (100.0)	446 (3.6)	138 (1.1)	805 (6.5)	10,303 (83.0)	725 (5.8)

Source: Report on Survey of Labour Conditions in Machine Tool Factories in India, op.cit., p. 6.
Figures in brackets represent percentage of the total working force.

¹ The Government of India, Ministry of Labour and Employment, Labour Bureau: Report on Survey of Labour Conditions in Machine Tool Factories in India, New Delhi, p. 5.

The total working force in the industry comprised mostly of production and related workers. The proportion is greater in small factories than in large ones. The greater proportion of technical personnel, also that of executive and managerial personnel in large factories may be noted.

Composition according to Skills

The labour force (production and others) is generally sub-divided into four categories such as highly skilled, skilled, semi-skilled and unskilled. The skill required for the job, competence of the worker, the experience and the length of service are taken into account to place a worker in a particular category. The composition of the labour force according to these categories differs from factory to factory and can be taken as a rough guide as the level of technique at which the firms operate. Some techno-economic indices are given in Table 6.2.

As the figures show, HMT has a greater percentage of highly skilled and skilled workers employed. Other firms employed comparatively fewer highly skilled and skilled workers and made use of greater number of semi-skilled and unskilled workers. The data were available from 1960 onwards and the composition showed very little variations in the proportions of different categories. For example, in 1960, the percentage of direct workers (those directly involved in production as opposed to indirect ones who are mainly helpers) in HMT 83.50 of the total. Similarly for other firms, the

Table 6.2 : Composition of Labour Force in Some Factories as in 1963

	H.M.T.	Mysore Kirloskar	Praga	Cooper	Investa
Direct labour	2,942 (83.10)	1,605 (81.10)	769 (74.66)	307 (66.45)	(69.42)
Highly skilled	463 (13.08)	22 (1.11)	38 (3.68)	6 (1.29)	(1.12)
Skilled	1,639 (46.30)	216 (10.92)	179 (17.38)	52 (11.26)	(12.25)
Semi-skilled	838 (23.67)	1,040 (52.55)	538 (52.53)	249 (53.89)	(58.7)
Unskilled	600 (16.95)	500 (25.27)	186 (27.06)	77 (20.35)	(28.12)
Total Labour Force	3,540 (100.0)	1,979 (100.0)	1,030 (100.0)	462 (100.0)	645 (100.0)

Notes: Figures in brackets represent percentage of total labour force.

The figures show average daily employment during the year.

Source: The data from the machine tool firms.

percentages of these categories did not vary markedly over the years. If the data regarding the breakdown into categories of workers were available over a longer period, some inference could be drawn about the changing levels of skills employed. In 1953, Mysore Kirloskar employed 823 workers, out of which,

highly skilled workers were 10 (1.2 per cent); skilled 113 (13.7 per cent); semi-skilled 379 (46.1 per cent) and unskilled 321 (39.0 per cent). When these figures are compared to those of Mysore Kirloskar in 1963, it is seen that the percentages of highly skilled and skilled workers have not changed greatly, but the firm has employed greater proportion of semi-skilled workers than that of unskilled ones. The position in 1963 shows, that except in HMT, where skilled and highly skilled workers form 60 per cent of the total labour force, in other factories, the proportion of skilled and highly skilled is from 10 to 20 per cent of the total number of workers. These proportions can be usefully compared with those in the machine tool factories in the U.S.A. and West Germany, where the proportion of skilled and highly skilled workers employed comes to 70 to 80 per cent of the total workers.¹

The Methods of Recruitment

Though various methods are used for recruitment, the most common practice is to make the recruitment directly at the factory gate, especially for the recruitment of unskilled workers. Workers are sometimes recruited through labour office or through employment exchanges. Highly skilled jobs

¹ The Report of the Indian Productivity Team The Machine Tool Industry in West Germany, U.S.A. and Japan. The National Productivity Council, New Delhi, March 1963, p. 30. These are rough comparisons as what categories of workers are referred to as skilled and highly skilled, is not known.

of machinists, fitters etc. are also advertised in the newspapers. Quite often, a person is preferred if he happens to be related to some senior worker in the factory. This way, it is possible to keep some control over the new worker.

The Level of Literacy and Education

In the firms studied, a high level of literacy was found among production workers. Similarly, there is a high level of education especially among skilled and highly skilled workers. Many of the highly skilled and skilled workers had passed their S.S.C. examination, some had I.T.I. certificates.¹ Among these categories, a marked ability to follow instructions or texts on workshop technology in English is seen. Among the categories of semi-skilled and unskilled workers, the level of education is low, but once the supervisors have interpreted the instructions in regional languages, they can proceed to work. No data is available on the relationship between a higher level of education and the productivity of worker. The discussions with the supervisors and other executive personnel in the firms studied,

¹ The Secondary School Certificate Examination (S.S.C.E.) is conducted, twice a year, by Statewise S.S.C. Boards in India. A student appears for this examination, after completing his high school studies.

Industrial Training Institutes (I.T.I.) have short-term courses to impart to the students practical workshop training. A student is, generally, admitted after his S.S.C. examination.

suggested that a higher level of education helps the worker to view his job in a broader perspective and leads to better performance. Nevertheless, there were some ^{barely literate} workers employed for more than a decade in a factory, who were very thorough in their work, had a keen eye for precision in job and needed least mechanical aid for testing its accuracy.

The Length of Service

According to the Bureau Report, in December 1959, in large factories, 26.5 per cent of workers had been employed for more than 10 years; 21.4 per cent employed less than 10 years but more than 5 years; 52.1 per cent had a service of less than 5 years, (out of these 52.1 per cent, 21.2 per cent were employed for a period less than a year). As most of the firms in the industry have been started during post-independence years, it is obvious that the majority of the workers should have been employed for a short duration of time.¹ In the three factories studied which were started in 1940's, only about 10 per cent of workers had served for 15 or more number of years, while 40 per cent of the workers had been working for only less than 5 years. One reason may be that the majority of workers might have been employed only after substantial expansion which took place after 1956 in the case of factories studied. It may also indicate that

¹ The Report on Survey of Labour Conditions in Machine Tool Factories in India, op. cit., p. 11.

the workers choose to change jobs from factory to factory. This is understandable as there is a great demand for skilled workers in newly established engineering firms and workers, who after an experience of a few years in one factory go to the other factory in search for better prospects. In small factories, 63.5 per cent of the workers had put a service of less than one year.¹ The main reason for higher proportion of workers with shorter length of service in small factories may be the lower rates of wages in small establishments.

In the four factories studied, the percentage of workers having put in a service of less than one year was much smaller than in the percentage given in the Bureau Report. This may be possibly due to the fact that these concerns are established for a long time and workers stick to the old established concerns out of reasons of security and sentiment. In Investa about 18 per cent of the workers had left before they completed one year. In Cooper and HMT, 16 and 12 per cent of workers respectively had put in less than one year's service. In Mysore Kirloskar this percentage was still less, only 8 per cent. It may be that, if the firm is located at a centre where there are a number of engineering concerns, the workers tend to change jobs often. This may explain why percentage of workers with less than a year's service is higher in Cooper and Investa at Poona than in Mysore Kirloskar at Harihar, the place with only one firm.

1 Ibid, p. 11.

Labour Turnover and Absenteeism

The Table 6.3 gives the rates of labour turnover and absenteeism in machine tool factories during 1959. In the case of large factories, the highest accession rate (workers joining the factory) is in the month of May and the lowest in the month of September. The highest separation rate (workers leaving the factory) for large factories is in April, the lowest rate being in October. The accession and separation rates are considerably higher for small factories. The rates fall from May to October again to rise from December onwards.

Table 6.3 : Estimated Rates of Accession, Separation and Absenteeism in Machine Tool Factories in 1959 (In Percentages)

Month	Accession Rate		Separation Rate		Absenteeism	
	Large factories	Small factories	Large factories	Small factories	Large factories	Small factories
January	4.1	11.8	2.8	7.3	10.4	10.2
February	4.4	9.4	4.0	10.6	10.9	11.2
March	4.0	11.3	4.2	16.2	12.6	11.5
April	5.0	15.2	6.4	17.3	14.0	10.4
May	5.4	14.5	3.9	12.7	13.5	10.8
June	4.3	14.2	4.7	11.0	12.4	13.0
July	3.7	16.2	4.2	17.2	8.6	10.6
August	3.8	10.0	3.5	11.1	8.8	10.2
September	2.3	11.4	3.4	11.7	9.3	9.2
October	2.6	14.1	2.5	8.6	9.6	10.1
November	4.4	16.1	2.8	13.2	10.7	12.0
December	3.5	11.2	2.9	17.9	9.5	10.5
Average 1959	3.9	13.0	3.8	12.9	10.8	10.8

Source: The Report on Survey of Labour Conditions in Machine Tool Factories in India, op.cit., pp. 12-13.

These rates are in respect of production workers (excluding unpaid apprentices and casual workers) employed directly by the managements. The percentages of production workers joined, left, or absent to the total production workers employed during the month are presented.

The rate of labour turnover in the five factories studied was from 4 to 7 per cent, an average for the year 1963-64. The monthwise details were not available, but it was reported that the highest rate of labour turnover occurred in the months of April and May, the lowest being in the months of October and November.

In the Table 6.4 are presented percentages of man-days lost due to absenteeism to the total mandays during the month, for the three factories studied.

Table 6.4 : The Ratio of Mandays Lost to Total Mandays during the Month

Month	Praga Per cent	Cooper Per cent	Mysore Kirloskar Per cent
January	19	11	10
February	16	12	10
March	21	15	12
April	14	14	13
May	17	20	15
June	13	15	14
July	10	9	10
August	8	9	6
September	10	10	6
October	9	11	6
November	10	10	8
December	10	12	12

Source: Data from the firms.

The percentages of mandays lost to total mandays are on the high side for all the three firms, from January to May. The low rates for absenteeism are found from July to November.

The high rates in April and May are due to workers going to their native places on leave. The rates of absenteeism again increase in harvesting season. The trends shown by the data for three firms are broadly similar to those as revealed in the figures by the Bureau Report in Table 6.3 presented earlier.

Wage Structure

There has been no standardisation of wages in the machine tool industry on a countrywide basis. The wage rates differ not only from one centre of industry to the other but at times even between the units at the same centre. The wage structure in a particular unit was found to have developed either on the basis of the prevailing rates of wages in that area or was the result of the bargaining between the employer and the union. In Punjab, however, the State Government has brought the industry within the purview of the Minimum Wages Act and has fixed the minimum rates of wages for broad categories of workers in 1958.¹

The Table 6.5 indicates how wide variations are found among the basic wage rates of workers of different categories. These rates exclude allowances and bonuses, and refer to the year 1964-65.

¹ Ibid, p. 16. The Bureau Report found that a large number of units in Punjab were not paying the minimum wage rates fixed under the Act.

Table 6.5 : Basic Wage Rates in Some of the Factories (Categorywise)

Factory	Category			
	Highly Skilled (Rs.)	Skilled (Rs.)	Semi-skilled (Rs.)	Unskilled (Rs.)
Cooper	A) 4.00-0.35-5.25 E.B. 0.40-7.5 E.B. 0.40-10.5	A) 2.50-0.20-3.50 E.B. 0.25-4.50	A) 1.50-0.09-1.95 E.B. 0.13-2.60	A) 1.12-0.06-1.45 E.B. 0.05-2.00
	B) 3.00-0.35-4.25 E.B. 0.40-6.25	B) 2.00-0.12-2.60 E.B. 0.15-3.50	B) 1.25-0.09-1.95 E.B. 0.09-2.00	B) 1.00-0.03-1.51
Mysore Kirloskar	A) 4.25-0.25-6.35	A) 2.24-0.16-3.20 E.B. 0.19-4.00 E.B. 0.20-5.00	A) 1.65-0.12-2.25 E.B. 0.15-3.00	1.00-0.07-1.28 E.B. 0.08-1.60
	B) 4.24-0.21-5.50	B) 2.24-0.16-3.20 E.B. 0.19-4.00	B) 1.35-0.12-2.10	
			C) 1.15-0.12-1.90	
Praga Tools	A) 6 to 8.50	A) 3.8 to 4.4	A) 1.12 to 2.12	A) 1.2 to 2
	B) 4 to 6	B) 2.12 to 3.8	B) 1.00 to 2.12	B) 1.00 to 2.12
	C) 4.4 to 5.4			
H.M.T. (Monthly* Wage Rates)	160-12-280 E.B. 15-310 (6.15-0.46-10.77 E.B. 0.58-11.90)	A) 145-9-235 E.B. 10-255 (5.58-0.35-9.04 E.B. 0.38-9.81)	A) 115-7-185 (4.42-0.27-7.12)	A) 85-5-135 (3.27-0.19-5.19)
		B) 130-8-210 (5.0-0.31-8.08)	B) 100-6-160 (3.85-0.23-6.15)	B) 70-4-100 (2.69-0.15-3.84)
			C) 85-5-135 (3.27-0.19-5.19)	
Investa	A) 4.00-0.30-5.00 E.B. 0.40-7.00	A) 2.50-0.25-3.50 E.B. 0.25-4.50	A) 1.50-0.10-2.00 E.B. 0.15-2.80	1.00-0.05-1.50
	B) 3.00-0.30-4.00 E.B. 0.40-6.00	B) 2.25-0.15-2.75 E.B. 0.15-3.75	B) 1.25-0.10-2.00 E.B. 0.10-2.15	

* A substantial part of the dearness allowance is consolidated with the basic wages paid by HMT.

Source : Data from individual factories. Figures in brackets for HMT indicate roughly the daily wages. These figures are derived by dividing the monthly wages by 26 days.

Other Earnings

Next to basic wage, a major component of the total wages paid to the workers is the dearness allowance. At times, the dearness allowance is merged along with the basic wage. When it is paid as a separate component, it is either linked with the consumer price-index number or the payment is paid at a flat rate to all the workers. Very seldom it is paid on a slab basis. The proportion of the dearness allowance to the basic wage differed from factory to factory. In one factory, the dearness allowance amounted to one-fourth of the basic wage, in another it was one and half times the basic wage.

Next to the basic wage and dearness allowance, an important element of total earnings of workers in the industry is production or incentive bonus. The production or incentive bonus schemes are generally applicable only to production workers.

In addition, there are ad hoc allowances, overtime allowances, attendance bonus, night shift allowance, transport allowance, house rent allowance etc.

According to the Bureau Report, of the average daily earnings of Rs.4.48 of all workers in machine tool industry in December 1959, the basic wages and dearness allowance formed a major part (Rs. 3.91 or 87.3 per cent). Next came the production or incentive bonus (Rs. 0.52 or 11.6 per cent). The overtime allowance came to Rs. 0.04 or 0.9 per cent. The share of night shift allowance, house rent allowance, etc. in

the average daily earnings was insignificant.¹

There are annual bonuses paid such as profit bonus, year-end bonus, festival bonus etc. The system of paying profit bonus was observed in only two factories studied. The payment was the consolidated wages of certain days in a year. The Bureau Report notes the practice of paying 'Pooja Bonus' in the machine tool factories of West Bengal.²

Welfare and Amenities

Amenities and welfare activities undertaken by employers fall under two categories: (a) obligatory i.e., those prescribed under the law, and (b) non-obligatory i.e., those which are not statutory but are being provided by the employers of their own accord.

Under the Factories Act, 1948, the obligatory welfare facilities cover such items, as washing facilities, facilities for storing and washing clothes, rest shelters, first aid appliances, canteens and lunch rooms.

The non-obligatory facilities include recreational facilities, educational facilities, co-operative societies, housing etc. In all the factories studied, the cost of such activities was being entirely met by the employers. The answers to mailed questionnaire indicated that in nine factories, the cost was shared jointly by the managements and workers.

1 Ibid, p. 20.

2 Ibid, p. 24.

The important non-obligatory activity to which both the Government and the factories are now providing attention, is that of providing housing accommodation to the workers. Prior to Independence, Land Acquisition (Amendment) Act, 1933, enabled the employers to secure land for the construction of houses for their employees.¹ From 1946, separate laws in various States have been passed. The Bombay Housing Board Act of 1948 and amendments afterwards, authorised the constitution of a Housing Board which under the authority of the State Government is empowered to execute the housing schemes for the industrial workers.² Similar laws have been passed in other States, enabling the State Governments to frame and execute the housing schemes for industrial workers.³

It is believed, though not positively established due to difficulty of isolating a factor from other factors, that providing housing accommodation to workers results in better productivity. It was also reported by some of the officials that the rate of labour turnover was less among the workers who were allotted housing accommodation. On the other hand, a group of officials maintained that the burden of providing non-obligatory amenities, especially housing, was becoming

1 The Government of India: Indian Labour Year Book, 1964.

2 Ibid.

3 For example, Mysore Housing Board Bill 1953 and amended in 1962. Similarly, Hyderabad Labour Housing Act, 1952, and the Andhra Pradesh Housing Board Act, 1956, later extended and amended in 1962.

onerous to the managements. It was argued that the firms should not sink a part of the capital in the housing but should invest it in the machinery and equipment leading to production. In a country, where the capital is scarce, the firms, according to this viewpoint, should not be asked to waste a part of capital in non-productive activities.

The outcome of the debate would depend on the perspective within which the problem is viewed. If the approach of return on capital alone, is not followed, the provision of housing appears necessary from the viewpoint of social welfare.

Some of the leading firms have made considerable progress towards providing the non-obligatory facilities to workers. The best example of such facilities was seen in HMT at Bangalore. The HMT has built colonies for workers and other employees, hostels for bachelor employees, auditorium, shopping centres, hospitals, children's parks and kindergarten and a high school. The HMT township at Jahhalli near Bangalore consists of 1,984 residential houses.

The Mysore Kirloskar has also developed a township at Harihar with residential houses for workers and officers, a club with recreational facilities, a school and a library.

The Investa and the Cooper at Poona have schemes for housing. The New Standard Engineering at Bombay has built a few residential quarters for workers. The NSE gives scholarships to the children of workers for the high school

and college education. The answers to the mailed questionnaire indicate that many firms have schemes for providing housing and other amenities to workers though at present they have made much effort in that direction.

Trade Unionism

There has been a fair growth of trade unionism in the machine tool industry as can be seen from the Table 6.6. The data are also presented for some other industries.

Table 6.6 : The Extent of Trade Unionism in Machine Tool and Other Selected Industries in 1960-61

Industry (I)	Employment (II)	Membership (III)	Percentage of Col. III to Col. II (IV)
1) Textiles	1,206,000	655,000	54.3
2) Paper and Pulp	42,000	20,000	47.6
3) Basic metal industries	178,000	147,000	82.6
4) Manufacture of machinery except electrical	215,000	61,000	28.4
5) Manufacture of electrical machinery	87,000	24,000	27.5
6) Machine Tools			
a) Large factories	8,576	4,638	54.1
b) Small factories	3,178	466	14.7
c) Total (a + b)	11,754	5,104	43.4

Source : Data for Machine Tool Industry are taken from The Report on the Survey of Labour Conditions in Machine Tool Factories in India, op.cit., p. 46.

Data for other industries are taken from Indian Labour Statistics, 1964.

The figures show that there is a considerable growth of unionism in the machine tool industry. It is especially marked in the case of large factories. The growth of unionism in the machine tool industry is much less when compared to that in textiles or basic metal industries. The unions in the textiles are operating for a very long time and they are well entrenched. However, the extent of trade unionism in the machine tool factories is marked, when compared to that in machinery industries, both electrical and non-electrical. When it is considered that most of the machine tool firms have been of a recent origin, the growth of unionism is marked.

The growth of unionism can be attributed to a number of factors. The level of education of production workers in machine tool factories is fairly high. There are no laws regarding the minimum wages applied to the industry, neither is there any standardisation of wages. These provide reasons for disputes between the employers and workers. Disputes also arise out of claims under various Labour Acts.

Inter-Union Rivalry

One of the chief features regarding trade unionism in most of the factories studied, was the infighting between two or more unions for recognition. The inter-union relations, more often than not, played a dominant role in deciding the nature of industrial relations at a plant where union membership was divided between unions. The rivalry between

unions at times led to serious disputes and a fall in production.¹

In the machine tool firms studied, it was observed that many unions existed in the same firm, affiliated to various political parties, such as Congress, Sanyukta Socialist Party, Jana Sangha, Communists, etc., with often a non-worker as the President of the Union. Thus in addition to the rivalries

1 (a) In Praga Tools in 1959-60, a dispute arose for recognition between the Workers Union, an established union affiliated to the Hind Mazdoor Sabha, and The Employees Union a body formed by the dissident group with the Secretary of the Andhra Pradesh Trade Union Congress as its President. An inter-union rivalry led to riots and a fall in production of the factory during that year. The Praga Tools Ltd., Annual Report 1960, pp. 6-7.

(b) In 1959, the Hindustan Machine Tools Employees Association, an independent union with leanings towards All India Trade Union Congress (AITUC) presented to the management a charter of demands, relating to increases in wages, other emoluments and amenities. The management declined to grant the demands which were considered to be unreasonable. After an unsuccessful attempt at conciliation in May 1959, the Government of Mysore referred seven of the main items of this dispute to adjudication of the Industrial Tribunal at Bangalore. In the meanwhile, rift in the union, occasioned by an attempt by the union to organize a strike while the matter was still pending before the Tribunal, led to the formation of a rival union, the Hindustan Machine Tools Karmika Sangha in May 1959. This union was affiliated to the Indian Trade Union Congress (INTUC). The rivalry between the two unions was prolonged while the representative character of the union and the breaches in the code of Discipline by the Hindustan Machine Tools Employees Association were referred to the Labour Minister of the Government of Mysore for investigation and advice. There were cases of violence because of the rivalry between the unions. A Karmika Sangha worker died, the work of the factory was disorganized at several times. After a time the Karmika Sangha was recognized by the Company as its most representative union.

Government of India, Ministry of Labour and Employment, Implementation and Evaluation Division. Industrial Relations in The Hindustan Machine Tools Ltd., Bangalore - A Case Study (1957-1962), New Delhi, pp. 12-18.

among unions based on personality conflicts and the differences regarding the methods of dealing with the management, there is a rivalry based on political affinity as well.

Works and Joint Committees

Works committees, obligatory for those industrial establishments employing 100 or more workers, constituted under the Industrial Disputes Act 1947, and other Joint Committees constituted under supplementary State Acts, provide a forum of mutual discussion of matters concerning day to day relationship between employers and employees, so that the friction can be eliminated in the initial stages and amity and good relationship between the two parties can be ensured. There are approximately equal number of representatives both from workers and employers in the units where such committees existed. From stray records which are available, or from the information given by managements and workers, it seems that issues related to such matters as issue of attendance cards, a grant of increments to some category of employees, payment of advances in causes of need, production bonus and annual bonus etc. In a way, the functions performed by the Works Committees and trade unions in the factories seem to overlap each other.

The HMT started an experiment of Joint Management, with workers participating in management, in the middle of 1958, on the recommendation of the Sub-Committee on Workers' Participation in Management and Discipline in Industry, of the

Government of India. The Joint Council of the HMT, with the representatives of the workers and the management dealt with such matters as supervision of safety measures, operation of vocational training and apprenticeship schemes, preparation of schedules of working hours, breaks during working hours, holidays, payment of rewards for valuable suggestions etc. All matters relating to wages, bonus etc., which were subjects of collective bargaining, individual grievances and any creation of rights as between employers and workers were outside the scope of the Joint Council. However, the experiment was discontinued during the labour management disputes in the middle of 1959, and does not seem to have been revived again.¹

The Productivity of Indian Machine Tool Worker

As the effectiveness of the machine tool factory worker differs from plant to plant depending on the type of equipment used, the living and working conditions, the composition of labour force according to skills, etc., the productivity of an Indian machine tool factory worker, roughly measured in

¹ Industrial Relations in the Hindustan Machine Tools Ltd., Bangalore - A Case Study (1957-1962), pp. 19-24. The Case Study points out that the Joint Council was not ineffective while it lasted. Actual experience, according to the Case Study, showed that the matters entrusted to the Council had been better administered with increased efficiency. The management of the HMT, however, discontinued the experiment, with the conviction that the workers had not yet reached that stage of maturity to participate in managerial functions with a due sense of responsibility.

terms of the output per worker per year, differs from factory to factory. For example, among six firms studied, HMT had the highest output per worker in 1963 (Rs. 18,548 per worker). The lowest down the scale was the Praga, whose output per worker in 1963 was Rs. 7,279. In 1963, the output per worker in the large scale factories in the organized sector of the industry in India was Rs. 14,007.¹

There are not any known figures, by which the productivity of the Indian machine tool factory worker can be compared with that of his counterpart in an industrially advanced country. Thus we have to depend upon the guesses based on observation by trained observers. Some comparisons regarding the productivity of an Indian machine tool factory worker and his counterpart in Europe are made by Shri S. M. Patil, the Managing Director of the HMT. On the basis of observation, (he states,) the efficiency of an Indian worker is believed to be between 60 to 80 per cent of that of his European counterpart. This observation is confined only to the direct production worker alone, but the overall productivity per capita in the industry is much lower than that in an industrially advanced country, as he shows with the following example.

¹ Computed on the basis of data of employment and output Annual Survey of Industries, 1963, Vol. III.

Workers employed in 1963 in large scale machine tool factories No.: 13,178.

Gross output in 1963 of large scale machine tool factories : Rs. 17,03,24,351.

Shri S. M. Patil presents figures for two comparable medium size machine tool factories, one in India and the other in Europe. In Europe, the average output in such a factory was (in 1959) of the order of Rs. 24,000 to Rs.30,000 per man per year, while in a comparable factory in India, the average output per man per year was from Rs. 4,800 to Rs. 6,000. Thus average efficiency of an Indian machine factory worker is as low as 20 to 25 per cent of that in a European machine tool factory.¹

Thus even if the wage rates in a European machine tool factory are four to six times as high as those in an Indian machine tool factory, according to Shri Patil's calculations, four to five men are employed in an Indian factory to produce a level of output which can be produced by one man in a European factory. Thus the advantages of low wage rates in India are offset by the low productivity of the worker.

Incentives to Increased Productivity

All the firms studied, and most of the firms which answered the mailed questionnaire, have started incentive payment systems to increase the productivity of workers. Individual incentive schemes were applied for certain machines for certain jobs, and were applied to production workers only. The standards for the job were arrived at by estimating

1 A Case Study of Indian Machine Tool Industry, op.cit.

the time required for the job on the basis of standard data and by correcting these estimates with due allowances for personal needs, rest, interference etc. The bonus rates are arrived at for each job, after taking into consideration the standard time required for the job. Praga had applied group incentive system to certain departments, such as assembly, where the rate of output for the group was used as the determinant of bonus or premium. One cannot know, in the absence of precise data as to what extent the incentive payments system has led to an increase in production or whether it is the result of increase in labour skill or organisational co-ordination.

Training Schemes for Workers

Employees in the industries where a simple processing of raw materials is needed can be trained in a shorter time than those in machine tool factories where the production processes are more complex and operations on the machines require particular skills. The problem of getting skilled workers is faced by most of the machine tool factories, especially by those located in centres where the industrial development has recently taken place.

The Apprenticeship Act by the Government of India in 1961, came into force in 1963, providing for the regulation and training of apprentices in trades and other matters connected therewith. The Act made it imperative for the industrial units with 500 or more workers employed, to recruit

and train certain number of apprentices in the notified designated trades.¹

All the firms had some sort of training programmes, though in most of the factories, there were no systematic arrangements and training was imparted on an ad hoc basis. The period of training varied from trade to trade and from factory to factory. The emoluments for the duration of training also were not uniform. These ranged from Rs. 25 to Rs.75 per month. Generally, factories guaranteed regular employment to their trainees after they had successfully completed the training course.

The programmes for training included Workshop Calculations, Engineering Drawing, and Trade Theory. These consisted of solving examples regarding speeds and feeds, taper and offset, reading blue-prints, the use of engineering equipment, the methods of using calipres, micrometers, vices, etc. The advanced course of Trade Theory consisted on training the worker to operate on lathes, drills, milling machines etc. After the initial theoretical training for the first six months or a year was over, the worker was sent to the shop for actual experience.

HMT has paid perhaps the most careful attention to the training of workers from the very beginning. During the

¹ Following trades are designated: Fitter, Turner, Machinist, Pattern maker, Moulder, Blacksmith, Sheet Metal Worker, Welder, Electrician, Lineman, Wireman and Carpenter, etc. Indian Labour Year Book 1964, op.cit.

period, while the new unit is being set up, the workers are being trained so that they can be available when the new unit is commissioned.

The HMT Training Centre was taken over by the Government of India from 2nd November 1959, to be run as a 'Government Machine Tool Training Centre' for the highly skilled workers required in the machine tool factories, as well as in other industries. The training schemes are also provided for graduate and diploma engineers at this training centre. The Company continues to manage the centre on behalf of the government.

The training schemes for various categories in HMT are as presented in Table 6.7.

Table 6.7 : Training Schemes at the HMT Training Centre

Category	Duration of Training	Requirement for Admission	Stipend	Post and salary after completing the training
1) Technical Trainee	2 to 3 years	Degree in Engineering	Rs.300 p.m.	Supervisor in the scale Rs.350-25-600
2) Artisan Trainee	2 to 3 years	Diploma in Engineering	Rs.150 p.m.	Technician in the scale Rs.195-15-375
3) Craftsman Trainee	1 year	Certificate from Vocational Training Institute	Rs.90 p.m.	Skilled Workers in the scale Rs.115-7-185

Source: Government of India, Estimates Committee (1963-64), Fifty-Second Report, Third Lok Sabha. Personnel Policies of Public Undertakings. Lok Sabha Secretariat, New Delhi, 1964, p. 145.

Another noteworthy example of a training scheme was that of 'Audyogik Tantra Shikshan Sanstha', an industrial co-operative training school of which eight industrial units around Chinchwad (Poona) are the members. The member-units included two machine tool factories, two automobile and automobile ancillary units, and four other machinery manufacturing units. The remarkable fact about this training school was the joint effort made by several firms to train the workers. The number of apprentices rose from 3 in the beginning in January 1964 to 260 in August 1965. The firms provided the experienced staff of instructors. After six months of basic training in the school, the apprentices are sent to respective factories for in-the-shop training.¹

Supervisory and Managerial Personnel ²

Next to workers, the supervisory and managerial personnel engaged in the manufacture of machine tools is to be considered. In India, where the workers are to be imparted skills necessary for the manufacture of machine tools and scarce capital resources are to be fully utilized, the role of supervisory and managerial personnel in giving the

1 Audyogik Tantra Shikshan Sanstha : A Brochure.
Unpublished.

2 This section on supervisory and managerial personnel, is mainly based on the notes taken while visiting the machine tool factories. To a large extent, views represent personal judgements, though valid in the writer's opinion, could not be always substantiated with data.

leadership and instruction to the untrained labour is critically important.

The junior supervisors at the plant level can be divided into two broad categories. In the first category may be included charge-hands and assistant foremen. Persons from the category of skilled workers are promoted to these posts. The other category includes junior and senior supervisors. These include engineering graduates, diploma-holders in engineering, and persons who are graduates in Science (B.Sc.s) or have completed the first two years of the B.Sc. course.

The firms tended to have a large portion of their supervisors who had diplomas in Engineering or degrees in Science in preference to the degree-holders in Engineering. The proportion between the degree-holders, diploma-holders and science-graduates differs from one firm to the other. In HMT, Cooper and Mysore Kirloskar, these proportions in 1964 were 1:2:6; 1:1:1.5; and 1:2:5 respectively. The preference for science-graduates and persons having completed some years of the science course, and diploma-holders in Engineering over the Engineering graduates is probably due to the fact that less stipend has to be paid to the former than to the latter. In addition, while it is a good experience for an Engineering graduate to start his career from junior supervisory post, he is not content to be in that position for long. The desire to get specialized in some line or to get to the higher position at the plant level,

where he would get the opportunity to apply his superior technical knowledge, induces him to leave the job of a supervisor much sooner than either a diploma-holder or a science-graduate would do in a similar position. In 1964, it was difficult to get enough qualified engineering. In fact, it seemed to be a waste to engage Engineering graduates in junior supervisory positions which might not give enough scope to their knowledge. The Estimates Committee commented adversely on the high proportion of degree-holders in Heavy Machine Tool Plant at Ranchi, in which the ratio between degree-holders, diploma-holders and trained apprentices was found to be 1:0.8:0.5. The Committee notes in its report:

"The present policy of the Corporation seems to be to recruit degree-holders as probationers for manning the supervisory posts of foremen etc. The committee feels that degree-holders, who are scarce and more expensive should be utilized for design and technology, and diploma-holders and trade-certificate holders should be taken for supervisory posts of foremen etc., and avoid taking men of higher qualifications for jobs which could be manned by persons of lesser qualifications." ¹

Similar comments are also made by the Estimates Committee in connection with the personnel policies of public sector

¹ The Government of India, Ministry of Steel, Mines and Heavy Engineering; The Estimates Committee (1963-64), Fifty-First Report, Third Lok Sabha. Heavy Engineering Corporation Ltd., Ranchi. Lok Sabha Secretariat, New Delhi, March 1964, p. 69.

enterprises. Going into the question of appointing Engineering graduates in preference to diploma-holders to supervisory positions, the Committee notes, "... Such an arrangement is not desirable from many points of view. Firstly, there is a shortage of graduate engineers in the country. Secondly, it is costlier to appoint graduate engineers than diploma-holders. Thirdly, graduate engineers when entrusted with subordinate jobs, tend to be dissatisfied and always look for better jobs." ¹

In recent years, when the employment situation for engineers has become unfavourable, the engineering graduates are no longer scarce, though they are still costlier than diploma-holders or science graduates. The recent data from three firms showing the respective proportions of each category, however, does not indicate a significant change in the policies of these firms since 1964.

The trainees for the supervisory posts were recruited generally through advertising the jobs in newspapers. A few of the trainees were selected through having acquaintance or relation with the senior officers in the company. The caste and lingual group, did not, on the face of it, seem to be influencing the selection and promotion of supervisors, but

¹ The Government of India, The Estimates Committee (1963-64), Fifty-Second Report, Third Lok Sabha. Personnel Policies of Public Enterprises. Lok Sabha Secretariat, New Delhi, March 1964, p. 48.

in majority of the cases, the posts of supervisors were held by the persons belonging to the advanced castes of the areas in which the factories are located. A fair number of Maharashtrian Brahmin supervisors in the Mysore Kirloskar at Harihar (in the Kannad speaking Mysore State), Parsis in Investa (in Maharashtra), was, however, found. One is inclined to believe that castes and lingual group may be, to some extent, the determining factors in the selection of posts in the higher echelons.

Because of the lack of the work experience during the years of the university education or because of the specialized knowledge and skills that the recruits need to acquire before they are actually put on the jobs intended for them, post entry training has been initiated by many companies. During the training period, which might last from six months to five years, the trainees were given experience in various departments. More systematic arrangements for training of supervisors have made by HMT in his training school. The training, here, included both theoretical courses and practical experience.

Sometimes, trainees were sent abroad, mostly to work in the factories of foreign collaborators. Whenever, the number of persons to be trained was very large, technical experts from advanced countries had been brought on contract for a period of few years. In HMT, technicians from Europe, especially from Switzerland, trained the Indian technical

personnel during the early years of HMT's existence. Czech technicians, who played a significant role in starting Praga, imparted training to the Indian technical staff during the early years of the company.

The proportion of supervisory personnel to the total production workers differed from one factory to the other. In 1964, this proportion was 1:5 for HMT, 1:8 for Mysore Kirloskar, and 1:13 for Praga. These ratios are on higher side as compared to those in advanced countries. In West Germany, for example, the ratio of supervisors to workers was 1:25 in 1963.¹ This low ratio in West Germany may possibly be due to the mass production techniques employed in the manufacture of machine tools, as well as due to possibly higher educational level and initiative of West German workers as compared to their Indian counterparts.

The basic remuneration of the junior supervisors after completing the period of apprenticeship differed from one firm to the other, ranging from Rs. 150 to Rs. 500 per month. In addition to this basic remuneration other allowances such as dearness allowance etc., were given. Senior supervisors earned from Rs. 500 to Rs. 1200 per month plus the allowances. The levels of remuneration of junior supervisors did not significantly differ from those of apprentices, and there was a wide range between the remuneration of bottom level of

¹ Heavy Engineering Corporation Ltd., Ranchi, op.cit., p. 69.

supervisory staff and that of the top level managerial personnel, who earned from Rs.2000 to Rs. 4000 per month in addition to other facilities in cash or kind. The disparity in levels of remuneration also tended to extend to the levels of status, and junior supervisory personnel often complained of 'being taken for granted'. It was alleged that plant managers and department heads did not pay enough attention to the practical operating problems of supervisors, working in direct contact with the workers, and that their suggestions were not paid enough attention while the policies were being formulated. The supervisory organization was characterized by a concentration of power at the top and the hesitation to delegate responsibility to the junior staff. This indicates that, though western advanced technology and equipment was accepted by almost all of the firms, the western methods of management were still not followed and the supervisory hierarchy was organized along small plant lines and an effective corps of middle management was absent from most of the firms studied.

At the top level managerial personnel, distinction between production and administrative groups was observed, especially in firms in the private sector. The production and engineering personnel were supposed to be technical specialists taking decisions regarding the technical aspects of the operations of the factory. The administrative personnel was found both at the factory and at the managing

agency (or secretaries and treasurers) headquarters. Though the managing director or the general manager was given considerable autonomy in routine matters, all major decisions relating to financial considerations were taken up by the persons at the headquarters. This meant that major policy decisions were taken with more weightage being given to the financial and commercial factors than technical ones. Indirectly such a practice tended to neglect the technical efficiency at the plant level. If, the managing director or the general manager of a firm was more closely associated with the group of managing agents (or secretaries and treasurers), as in the case of Mysore Kirloskar and N.S.E., his authority carried more influence on the policy decisions than those of other firms who were more or less employees of the managing agency groups.

The two machine tool companies in the public sector, viz. HMT and Praga, differ in organizational structure from those in the private sector, in that the former operate without managing agents. Nonetheless, in practice, the position of the managing directors of the public sector companies is not significantly different than their counterparts in the private sector. In routine matters, the managing directors of public sector units have considerable autonomy. The HMT managing director of HMT could make appointments upto Rs.1250 and the managing director of Praga, upto Rs. 600.¹ In other

¹ Personnel Policies of Public Undertakings, op.cit., pp. 119, 122.

technical matters regarding production, they could take independent decisions. But the major managerial decisions were made by high level Central Government officials and tended to involve political as well as industrial considerations. The checking by government auditors, various committees of the Government, and finally the possibility of complaints being voiced in the Parliament might have discouraged dishonesty, but it also tended to impede the initiative.

Growing awareness of paying attention to the organizational structure as well as technological considerations, gradual adoption of advanced methods of management will probably introduce a significant change in the composition and quality of the supervisory and managerial personnel of the machine tool industry in future. Already a few firms have made efforts in this direction and introduction of new technology and government policies are likely to speed up this process.

In this area of the industry, as well as in others, the role of bold entrepreneurship can hardly be exaggerated. Some idea of the type of entrepreneurship which was instrumental in the growth of major machine tool companies in the past, can be had from the next chapter.

CHAPTER 7

CASE HISTORIES OF GROWTH AND ENTREPRENEURSHIP

In the previous chapter, the discussion was centred around the personnel contributing to the development of the machine tool industry. In the present chapter, the appraisal of the growth of the industry is attempted in terms of the histories of development of six major machine tool companies. Upto 1956-57, the companies in the private sector dominated the industry and contributed to its development. Beginning with 1955-56, a new pattern is emerging with the companies in the public sector, especially HMT, taking the initiative and lead in the development of the indigenous machine tool industry. To illustrate the contribution of machine tool builders in the private sector, the careers of Mysore Kirloskar, Investa, Cooper and New Standard Engineering (NSE) are described. To indicate the contrasting nature of leadership of companies in the public sector, the case studies of growth of Hindustan Machine Tools and Praga Tools have been given.

Companies in the Private Sector

The Mysore Kirloskar, Cooper and Investa machine tool companies were established during the Second World War period. The demand for machine tools for the purposes of war production and other capital goods could not be entirely met by imported British machine tools, and the British Government

was encouraging the Indian manufacturers to start the production of machine tools. Kirloskar Brothers Ltd. who had been manufacturing lathes and drilling machines in addition to the main production lines of ploughs, diesel engines, chaff cutters etc., since 1920, were asked by the then Indian Government to manufacture shell-turning lathes for the production of shells in India. It is said that the British Government was of the opinion that such lathes could not be manufactured in India and had conveyed its opinion to the Indian Government; but the inspectors of the Indian Government had inspected and approved of the prototype shell-turning lathes manufactured by Kirloskar Brothers at Kirloskarvadi and placed orders for lathes, planing machines, presses etc.¹

In view of the increased quantity of machine tools, which had to be supplied to the Government, Kirloskar Brothers Ltd. decided to establish a new company solely for the production of machine tools. In early 1940s, the Government of the princely state of Mysore had expressed their willingness to offer a suitable plot of land at Harihar (in the Mysore State) and other facilities, if Kirloskars established the factory in the State of Mysore. Sir Mirza Ismail, the prime minister of the Mysore State took active interest.

1 S. V. Kirloskar. Yantrikachi Yatra (यांत्रिकाची यात्रा) (The Life of Laxmanrao Kirloskar - in Marathi), Kirloskar Press, Kirloskarvadi; 1958: pp. 158-160.

The foundry grade pig iron from the Iron and Steel Works at Bhadravati was available at concessional rates. Hence, the Mysore Kirloskar was incorporated in April 1941 in the State of Mysore, with Rs. 5 lakhs of paid-up capital, the Government of Mysore partly subscribing to the share capital.¹

The policy of the British Government to foster the growth of machine tool production in India was also probably the cause of the establishment of Investa in 1942. The Investa Industrial Corporation Ltd. acted as managing agents, many of its directors being also the directors of the Tata Sons Private Ltd. With the establishment of Investa, the House of Tata undertook the production of machine tools in addition to its other interests in iron and steel, textiles, electricity etc.

Sir Dhanajishah Cooper, had started at Satara Road, a company named 'The Hindustan Engineering and Implements Ltd.' in 1932, to manufacture diesel oil engines. The company soon came into financial difficulties. Walchand Hirachand, a reputed industrialist in Maharashtra and promoter of many companies, including the Scindia Steam Navigation Company Limited, the Hindustan Construction Limited etc., offered to help. In 1939, when he decided to start a company for manufacturing motor vehicles, he also wanted to acquire a company for the manufacture of internal combustion engines

1 Ibid, pp. 160-162.

and other machinery necessary for the production of motor vehicles. Walchand Hirachand formed a new company, named 'The Cooper Engineering Ltd.' which was to purchase the Hindustan Engineering and Implements Ltd. The new company was incorporated in May 1940 at Bombay.¹

The policy of the then Indian Government contributed to the rapid development of these companies during the period of the Second World War. The Machine Tool Control Order was passed by the Government in February 1941. A machine tool controller was appointed who, considering the overall demand for machine tools during the War years, placed bulk orders with major units manufacturing machine tools. The products manufactured by Mysore Kirloskar, Investa and Cooper were simple types of lathes, drills and shapers. Almost the whole of their output was purchased by the Government. The security of market greatly helped the early development of these companies.

After the termination of the War, the demand for machine tools dropped down as the Government discontinued its purchases. By 1946, U.K. and U.S.A. started dumping in India their surplus machine tools produced during the War. Both these factors led to a lack of demand for the indigenous machine tools. The companies reacted to these adverse

1 G. D. Khanolkar: Walchand Hirachand, Vyakti, Kala and Kartritva (२५१११, ११११, ३१११ १११११) - (in Marathi)
Seth Walchand Hirachand Memorial Trust, Bombay: 1965,
pp. 444-449.

conditions differently. The Mysore Kirloskar, by diversifying its main production line of lathes, to include various sizes and types, had established its position in the civilian market. Between 1946 and 1950, it managed to pay 5 to 6 per cent dividends, double its gross profits, and double its investment in fixed assets. Its success is probably due to bold and aggressive leadership which was prepared to take risks and invest its funds in times of crisis.

The other two companies did not fare so well. The Cooper had been manufacturing diesel oil engines, agricultural implements and textile machinery in addition to machine tools and considered the production of machine tools only as a side line. The production of other marketable items was increased at the expense of machine tools. Investa was hit hard by the lack of demand for its products. The sales in 1950 were Rs. 6 lakhs as compared to those Rs. 8 lakhs in 1946. From 1947 onwards through 1950, it continued to incur losses.

Soon after independence, the Government of India started taking interest in the development of this key industry. The Report of the Machine Tool Panel had studied the state of the industry with a view to fostering its development.¹ With the beginning of the Five Year Plans, the continuous expansion

¹ Report of the Machine Tool Panel, op.cit., Recommendations, Chapter I, pp. 11-12.

of consumer goods industries and the need for increasing capacity in the field of Fertilizers, Steel, Cement, Jute and other basic industries resulted in an increase in demand for capital goods and machine tools. Need was felt to have a well developed machine tool industry at the earliest.

The Thacker Committee, appointed in 1954 to guide the Government to take the necessary action, made several suggestions in its report.¹ The main recommendation of the Committee was regarding allotting a pattern of production to the major units then existing in the country. The Committee felt that though the overall demand of machine tools was quite considerable, the demand for different types of machine tools, which could be manufactured during the Second Plan period was limited. Hence, it was felt that it was not wise, in view of the development of the industry, to have a large number of units manufacturing the same items competing with each other.

According to the recommendations of the Thacker Committee, Mysore Kirloskar was to specialize in lathes, Investa in drilling machines and Cooper in shapers. The Committee's recommendations gave, more or less, monopolistic positions to the major units in respect of some of the items of machine tools, and, with continuously increasing demand during the Five Year Plans, they found themselves in a sellers'

¹ Final Report of the Machine Tool Committee, op.cit., Recommendations, Chapter 1, pp. 14-15.

market, and they made the most of it. From 1951 to 1955, Mysore Kirloskar paid 5 to 6 per cent of dividends to shareholders. Its output was, however, more or less static though the production of more developed types of lathes was taken up. Cooper concentrated on the production of machine tools, though it still considered the machine tools as a side line. During 1951 and 1952, Investa showed small profits and its management noted that "the trade conditions for the machine tool manufacturers show signs of improving."¹ Nonetheless, Investa's performance during these years, on the whole, did not respond to the note of its management's optimism. From 1953 through 1955, it continued to incur losses, its sales in 1955 were only Rs. 7 lakhs, less than those in 1946. During these years, the company depended on engineering orders for diesel engine components to supplement its earnings from the sale of machine tools. In 1954, the earnings from engineering orders exceeded those for machine tools sales. During the years to come, the execution of engineering orders received, was a major part of Investa's activities, but its share in the total value of production decreased with substantial expansion in the production of machine tools since 1957 onwards.

The wary outlook of Mysore Kirloskar and Cooper towards increasing the capacity and development of advanced types

¹ Investa Machine Tools and Engineering Co. "Chairman's Statement." Annual Report, 1953.

and designs was somewhat modified during the Second and Third Plan period. The demand for machine tools had increased greatly during this period due to the development of heavy engineering industries and the policy of the Government of banning the imports of such items as were manufactured indigenously. Mysore Kirloskar carried out substantial expansion of its capacity and output during 1956 and 1965. Its sales increased to Rs. 387 lakhs in 1965 with an increase of over eight times that in 1956. The company made good progress in the manufacture of its existing lines of centre lathes as well as in the assembly and subsequently the manufacture of capstans and turrets. It paid 6 to 7 per cent dividends from 1956 to 1958 and afterwards paid about 12 per cent dividends subject to tax. It made handsome profits through all these years and ploughed back most of the profits into the expansion of business. A new branch factory of the company at Hubli was commissioned in 1965.

After 1957, the production of machine tools at Cooper had increased to an extent when it was felt necessary to establish a separate machine tool division. A new factory was built and commissioned at Chinchwad near Poona in Maharashtra in 1962.

For a long time, Investa had faced the problem of shortage of space for expansion at its works at Byculla in Bombay. A new factory built at Chinchwad was commissioned in 1962 and most of the operations were shifted from Byculla to the new factory. The production of Investa in 1964 had

increased by eight times that in 1956 and it had taken up the manufacture of more advanced types of drills and lathes. It had showed profits from 1957 through 1962. Nevertheless, Investa, during all these years had not been able to come out of the financial troubles which it faced throughout its existence. It had not paid any dividends to its equity shareholders right from its inception and dividends on cumulative preference shares were in arrears since 1949 onwards. An improvement in the profitability of the company was expected by the transfer of operations to its new factory to Chinchwad. The Chairman remarked that "the company's most difficult days are passed" and he hoped that Investa will "attain a position of high respect in the machine tool industry."¹ It, however, appears from the subsequent developments that his expectations were misplaced. The prevalent tight money conditions, the high interest charges that the company had to pay on its loans, under-utilization of capacity, the profit-margin on new products being insufficient to offset the increases in costs due to increase in prices of raw materials and increased wage bill etc., were the factors, to overcome which, Investa needed substantial financial resources. In 1965, it was decided to amalgamate Investa with TELCO² and a part of the company's chequered history was over.

1 Investa Machine Tools and Engineering Company. "Chairman's Statement" Twenty-first Annual Report, 1963, p. 12.

2 The Tata Engineering and Locomotive Company. The management of TELCO was interested in acquiring a machine tool manufacturing concern, with a view to start building special purpose machine tools needed for its own expansion.

With the beginning of recession in early 1965, machine tool companies, which had long been enjoying a sellers' market, found the demand for their products decreasing. Cooper curtailed the production of machine tools and concentrated on other items such as diesel engines. Compared to Cooper, Mysore Kirloskar fared better. Its sales increased from 1965 through 1967, it continued to pay about 12 per cent dividends (tax-deductible), nonetheless, its profits decreased during this period.

Both Cooper and Mysore Kirloskar had been started in small villages, Satara Road and Harihar, respectively. The growth of these companies has led to the growth of these villages and surrounding area and development of skilled workers from these parts. After 1960, however, Cooper established its separate machine tool division at Chinchwad near Poona, and Mysore Kirloskar started a branch factory in the city of Hubli, possibly to secure the advantages of marketing contacts and skilled labour available in cities. The major part of output of Cooper and Mysore Kirloskar, is still produced at their parent factories. A noteworthy feature of Mysore Kirloskar is its encouragement to the development of small ancillary industries around Harihar. The small units were given facilities in the way of provision of machinery on a loan basis, financial assistance, steady orders for sub-contracting etc. Among the twenty entrepreneurs, managing small units around Harihar in 1964, about twelve were previously working in Mysore Kirloskar and opened their

own workshops afterwards with the help of the company. A few of them, for example, Sonalkar and Shirur, have developed their own products.

Of the three companies studied in the foregoing pages, the success of Mysore Kirloskar is more striking than that of the other two. The success of Mysore Kirloskar, is apparently attributable to the competent leadership which was prepared to take risks and seize opportunities, at the same time manufacturing machine tools of reputed quality. This leadership seems to have come, not from any single outstanding entrepreneur, but from a number of professional managers, such as Jambhekar and R. L. Kirloskar who directed the development of the company after the end of the Second World War and during the period of two Five Year Plans.

Investa could not come out of the financial difficulties from the very beginning. It appears that there was no serious attempt to improve the quality of output or to build up new products. When the decision to expand and build a new factory at Chinchwad was taken, already many new machine tool companies, manufacturing similar products to those of Investa, had been in operation and the competition was keen. The management of Cooper also could have decided to start a separate machine tool division much earlier. The initial impetus given by the liberal policy of the Government towards the machine tool industry during the Second World War and two Five Year Plans was not fully exploited by these two companies and opportunities for development were missed.

The growth of New Standard Engineering (NSE) presents a contrast to the growth pattern of other three companies, described before. Mysore Kirloskar, Investa and Cooper were promoted by business houses which had already established themselves in other industrial and commercial activities, while NSE was initially started almost from the scratch and reached to its present position mostly due to the efforts of Jethabhai Patel, the founder of the company.¹

In 1939, Jethabhai Patel started his small machine shop at Byculla in Bombay in rented premises. Five workers were employed at his workshop at that time. He was quick to seize the opportunities provided by the Second World War. He added more machinery and better equipment, supplementing the machine shop with a foundry and a welding shop. Along with repair jobs, the company also started manufacturing oil burning equipment and accessories. Early in 1948, NSE's new factory at Coroll Road in Bombay was erected. Gradually new products were being manufactured at this factory, including industrial and foundry machinery and machine tools such as plate bending and hacksaw machines.

During 1950s, the growth of the company was very rapid. With the growth and diversification of NSE's operations, the need for more space to facilitate specialisation and rationalization was felt. In 1953, a running concern at Santa Cruz

¹ An account of NSE's growth is mainly based on Twenty-five Years of Service to Industry, published by NSE in 1964, supplemented by interviews with the officials of the company.

to start the production of sheet metal machinery was acquired. In 1956, the Empress Iron and Brass Works at Byculla was acquired. In 1959, NSE was amalgamated with Bujorji and Sons Private Limited and was converted into a public limited company.

In the course of its twenty years of development, the need for more space had been NSE's recurring experience. The problem was solved from time to time by acquiring some running concern. In 1960, the company started building new factories at Goregaon in Bombay, with a view to transferring all its operations there in the course of time. The operations now cover a variety of products, such as machine tools, steel structurals, castings and forgings. From 1960 through 1965, NSE has tripled its production, from Rs. 93 lakhs to Rs. 307 lakhs and paid out 10 to 12 per cent dividends. The recession affected the company when the output dropped by about 20 per cent between 1965 and 1967. The company promptly curtailed its production of machine tools and concentrated on other items.

The remarkably swift pace of growth has been the main feature of NSE's development. General economic environment during the Second World War and Five Year Plans helped this growth, but the success is mainly due to the entrepreneurial ability of its founder, Jethabhai Patel, who was prompt to seek and seize opportunities whenever such were available.¹

¹ The 'NSE Shoptalk' recognizes the contribution of Shri Patel.

"Anyway, NSE is Jethabhai,
who built it out of straight fui(?)

M.N. Karandikar, "NSE Shoptalk," We in NSE, October 1965, Vol. III, No. 1, p. 8.

Companies in the Public Sector

The machine tool factory of the Government of India at Ambernath in Bombay had been producing prototype machine tools since the end of the Second World War period, but the production of machine tools on a massive scale was undertaken by the Government, only when the Hindustan Machine Tools Limited at Bangalore was commissioned in 1954 and Praga Tools Company Limited at Hyderabad was acquired in 1958.

The origin of HMT could be traced as far back as 1947 to the recommendations of the Disposal Utilization Committee which advised the Government of India to start three units, one of which being a machine tool manufacturing factory.¹ Following this recommendation, the Government of India entered into a collaboration agreement with Messrs Oerlikon Machine Tool Works, Zurich, for setting up the Hindustan Machine Tool factory in 1949. The HMT was commissioned in 1954 after an interval of about five years, and thus the progress of the factory was considerably behind schedule during the First Five Year Plan. The targets visualized in 1951 were scaled down in a subsequent review of the scheme. The capacity of the factory was reduced from 1600 lathes to 400 lathes per annum.² The actual performance was considerably short of even the reduced targets, the number of

1 The Disposal Utilization Committee, op.cit. Recommendations, Chapter 1, p. 10.

2 Government of India, Planning Commission. Programmes of Industrial Development, 1956-61. New Delhi, 1956; p. 45.

machine tools manufactured in 1955-56 being only twelve. The experience was depressing. An expert from the United Kingdom Team called upon in 1954 to examine and comment upon the project, had already remarked that "... it (HMT) will prove a colossal financial failure, to my mind, it is the most glaring case of commercial immorality." ¹

During the early years of the Second Five Year Plan, the conditions improved. In early 1957, the Government of India took over the complete management and bought from Oerlikons their share capital in the company. The new management, headed by Shri Mathulla, the Managing Director, aimed at a programme of increasing plant utilisation and diversification of production. In the year 1956-57, HMT produced 135 machines valued about Rs. 50 lakhs. Afterwards, the production of HMT increased year by year. When the first factory at Bangalore reached its full capacity during 1960-61, its production reached 1002 machine tools worth about Rs.350 lakhs. Afterwards, HMT expanded its activities very rapidly.

The Government of India took over the control of Praga Tools, which was started during the Second World War years. The British Government, fearing the stoppage of communications through the Suez Canal, in case of the German advance into Middle-East, wanted to develop some armament factories in India, in order to supply ammunition to the troops

¹ S. M. Patil. Hindustan Machine Tools : Ten Years of Progress (mimeographed) Hindustan Machine Tools Ltd., Bangalore: 1963, p. 1.

fighting Japanese forces. A bren-gun factory was started at Hyderabad. Some Czech technicians who had fled to England from Czechoslovakia during the German occupation of that country, were brought to Hyderabad, to impart technical skills to workers.

When it was obvious that Germans would not reach the Suez Canal, the bren-gun factory was disbanded. The Czech technicians, now at a loose end, persuaded some businessmen in Hyderabad, Bombay and Delhi to establish a factory to manufacture cutting tools and small tools.

The company faced difficulties from the beginning. There were no skilled workers in Hyderabad at that time. There were only some artisans in railway workshops and the road transport organisation. Some of them were lured to work in the newly established company but the Czech technicians had to train most of the workers from raw recruits. Praga started its operations by 1944-45, but had immediately to face severe competition from U.K. and U.S.A., which started dumping surplus wartime goods in India after the War ended.

After independence, the princely state of Hyderabad continued to be politically unstable. The Rasakar movement was gaining momentum. The businessmen from Bombay and Delhi, who had initially participated in founding the concern, were afraid of the security of their investments, and sources of credit were drying up. The company faced difficulties in obtaining raw materials, stores, plant and machinery which

held up outside Hyderabad due to the restrictions then existing on the movement of essential materials into Hyderabad. Early in 1948, there was a scare in the local population and soon after the breakdown of negotiations between the Government of India and the State Government of Hyderabad, a considerable number of the office staff and technical personnel left Hyderabad, and production and other functions had to be carried out by limited personnel under great strain and damage to the efficiency. There was a gradual tapering down of orders and soon after the breakdown of political negotiations between the Indian Government and the State Government in June 1948, Praga was more or less isolated from all its customers in the Indian Union and the Government of India particularly. Soon after the Police Action in October 1948, the company found itself without any orders and considerable stocks which were accumulated during the previous months.¹

In January 1948, the Industrial Trust Fund of the Government of Hyderabad took over the company from the United Industrial Corporation Ltd., the managing agents of Praga since its inception.

By 1951-53, the company was manufacturing bench lathes, drills and small size milling machines. Still, the company was not able to boost up its sales of machine tools to a level adequate for its smooth progress. Hence a forge shop was

¹ The Praga Tools Corporation Limited. "Directors' Report." Annual Report and Accounts, 1948.

added to the machine tool factory. The company accepted orders for forgings from automobile and diesel engine manufacturers.

An eloquent comment on the operations of Praga Tools, at this time, is made by the U.S. Machine Tool Advisory Group. It notes ".... Presently, the operation seems to be badly cluttered up with many types of operations, ranging from gasoline and diesel engines valves, through crank shafts, railroad forgings, small lathes, tool and cutter grinders, drill presses, and other assorted items. Serious study be made of all these aspects and determination made as to whether or not it is desired to manufacture any or all of these items even at a profit. We feel that there are certain items which should be discontinued, unless they are being manufactured for purely patriotic reasons." ¹

The company still continued to show losses. By the end of 1957-58, the company had accumulated losses of the order of Rs. 31 lakhs. The company had borrowed heavily from the Industrial Trust Fund and the State Bank of Hyderabad. These measures being inadequate to solve Praga's financial difficulties, the State Government approached the Government of India for help. In 1958, the Government of India became the majority shareholder of Praga, contributing about 51 per cent of the paid-up capital of the company, the rest of the

¹ The Report of the U. S. Machine Tool Advisory Group,
op.cit., pp. 19-20.

paid-up capital being subscribed to by the Government of Andhra Pradesh (34 per cent) and the general public (15 per cent). Praga was the only company in the public sector, where the general public owned a part of the share capital.

From 1960 onwards, both HMT and Praga have grown substantially in capacity and production. In 1961-62, the second factory of HMT at Bangalore commenced its operations. In 1963-64, both the HMT factories at Bangalore almost reached their full capacity and produced 2,000 machines valued at Rs. 925 lakhs. The management of HMT decided to build three more machine tool factories, each capable of producing 1,000 machine tools initially during the Third Five Year Plan. Of these, one unit was to be financed by HMT out of its own resources. The third HMT factory was set up in 1962-63 at Pinjore in Punjab State, the fourth HMT factory at Kalamassery in Kerala was commissioned in October 1964, the construction work on the fifth HMT factory at Hyderabad in Andhra Pradesh was started in May 1964.

During recent years, HMT has diversified its production to include machine tools of many types such as high-speed precision lathes, milling machines, radial drills, cylindrical and universal grinding machines and various general purpose machine tools. In addition to the manufacture of machine tools, HMT started wrist watches since 1963. It also intends to start the manufacture of printing press machinery.

During 1960-61 and 1964-65, HMT has more than doubled its production, showed handsome profits and paid out about 10 per cent dividends every year.

Since 1965-66, HMT has been, to some extent affected by the continuing recession in the machine tool industry. The production targets during 1966 and 1967 were reduced to avoid large accumulation of stocks. It did not pay out any dividends during these years. The plans for duplication of Pinjore and Kalamassery machine tool factories contemplated in the Fourth Plan have been deferred till the demand picks up.

The apparent success of HMT can be attributed primarily to the ability of its professional managers who directed the affairs of the company since 1957-58, notably Shri Mathulla and S. M. Patil. There were other factors as well. The demand for precision and heavy machine tools in India was created since the early years of the Second Five Year Plan. HMT catered to this demand. The generous financial help by the Government of India helped the company to stabilize itself in its early years of existence. The Government of India is still the major customer of HMT's products and thus a secure market is promised.

Certain noteworthy features regarding the operations of HMT may be mentioned, such as, the training school for workers, the development of small scale ancillary industrial estate, the use of computers for production planning, etc.

The growth of Praga in recent years, as compared to that of HMT, was at a much slower pace. Its production dropped from Rs. 63 lakhs in 1959 to Rs. 48 lakhs in 1961.

With the appointment of Shri Kelkar in 1961 as a managing director, various measures were taken to improve the working of Praga. The number of surplus workers was reduced. In the past, the company almost worked as a job shop, working according to orders received. After 1962-63, the list of items offered was reduced drastically from some 200 varieties to about a dozen. The production activities were mainly concentrated on cutter grinders, lathe chucks, drill presses and machine vices. The small entrepreneurs were encouraged to start ancillary units. These measures apparently yielded results as Praga tripled its output between 1961 and 1966, showed profits from 1964 onwards and paid out about 3 to 4 per cent dividends in 1965 and 1966.

It seemed in 1964-65 that Praga had, to some extent, overcome its financial and technical problems, which had hindered the progress of the company since its inception. In 1965, the Committee of Expert Engineers of the Government of India assessed the company's position. The Committee observed, among other things, that proposed production in various directions had been achieved. On the administrative side, the Committee noted, that the company had been able to achieve substantial reduction in the middle overheads and a proper organization and structure of Praga had been established. The Committee felt that Praga had arrived at a stage, where it should be allowed to develop into a sizeable machine tool unit.¹

¹ The Stock Exchange Official Directory. The Praga Tools Ltd., The Stock Exchange Bombay, 1967.

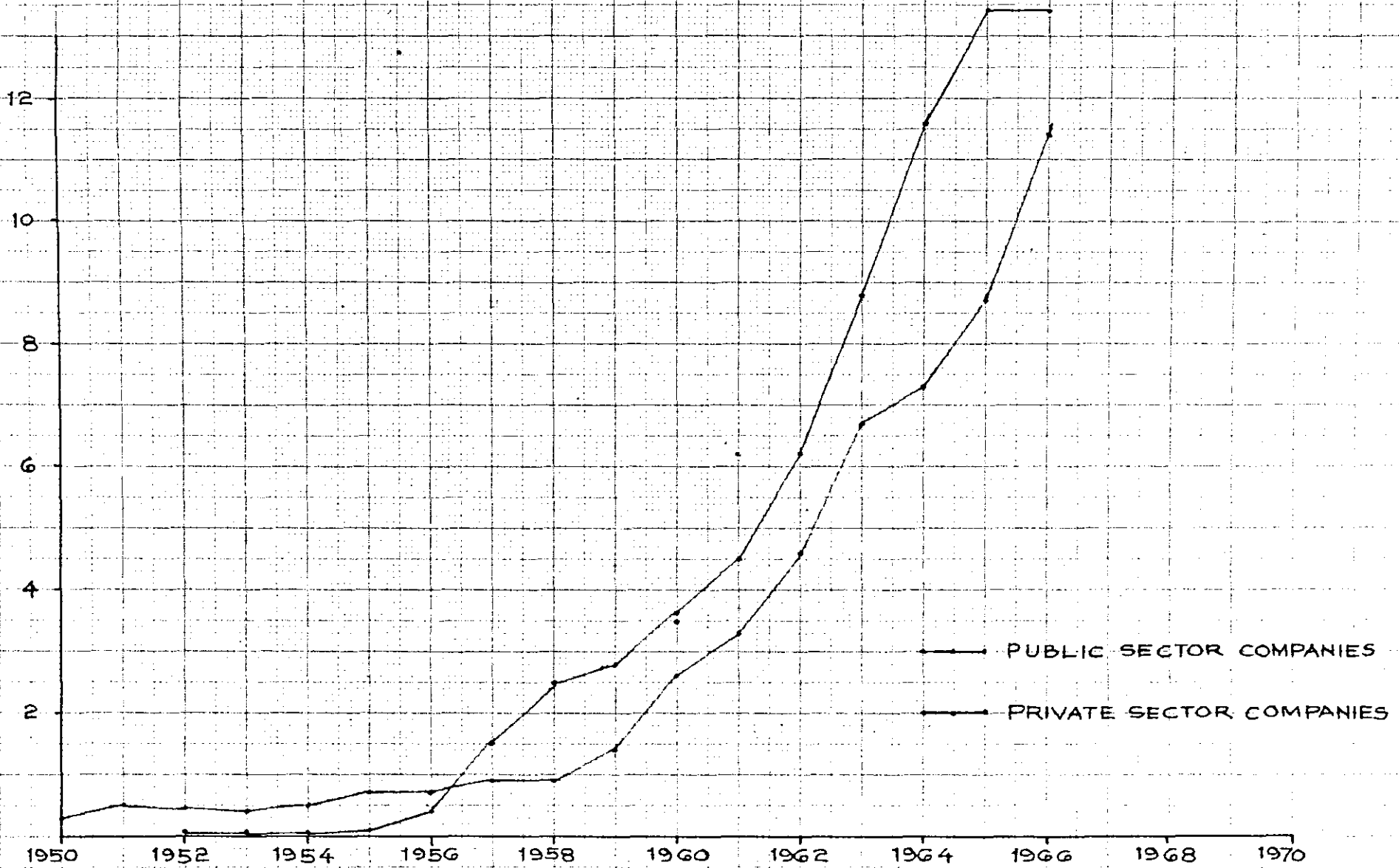
Praga, along with other machine tool companies, suffered from recession in the machine tool industry during 1966 and 1967, with the effect, that sales decreased and stocks of finished products continued to accumulate.

Since 1956, the share of the public sector of the Government of India in the indigenous production of machine tools has continued to grow at a rapid speed. This increase in the share of public sector has been mostly contributed by HMT, the level of output Praga and the Government's machine tool factory at Ambernath, being quite insignificant as compared to that of HMT. In Figure 7.1, the combined annual production totals of the companies in the public sector are traced since 1956 and are compared to those of the companies in the private sector.¹ The graph shows that the ascendancy of the private sector companies has been seriously challenged by public sector companies. Judging by the expansion schemes of the existing public sector companies and the creation of new machine tool factories at Ranchi, Bhavnagar and Ajmer, intended by the Government of India, it appears that in future the public sector companies will claim a very much larger share of the volume of production than the companies in the private sector.

1 Output data for companies in the public sector were arrived after combining the annual output figures for HMT, Praga and Ambernath Prototype Machine Tool Factory. Since 1962-63, the machine tool factory at Ambernath produces mainly equipment for the Ministry of Defence and its production of machine tools is almost negligible. The data were obtained from respective companies.

The output data for companies in the private sector were arrived at after subtracting annual output figures of public sector companies from the annual output figures of machine tools indigenously produced (Chapter 1, Table 1.1).

FIG. 7.1. COMPARATIVE PRODUCTION RECORDS
OF MACHINE TOOL COMPANIES IN
PUBLIC SECTOR AND PRIVATE SECTOR



Concluding Observations

The histories of growth of six major machine tool companies have been discussed in the previous pages. Another major company viz. The Batala Engineering Company Ltd. was started in early thirties and its pattern of growth is not unlike that of Cooper. Most of the other machine tool companies are producing machine tools only as a side line. Their growth is comparatively of a recent origin and is mostly due to impetus given to the machine tool production by the programmes of industrial development during the Second Five Year Plan.

The companies in their histories of growth do not show any uniform pattern. Mysore Kirloskar, Cooper, NSE and HMT succeeded by and large, to a fair extent, in stabilizing themselves. Investa and Praga had to struggle with adverse circumstances throughout a major part of their existence. While the general economic environment was more or less the same for all, the companies had to face with problems peculiar to themselves, regarding location, expansion schemes, finances etc. Both Investa and NSE were located in Bombay and as they grew larger, they felt the lack of space for expansion and had to move to other sites. Mysore Kirloskar and Cooper were located in small villages and later on transferred a part of their operations to cities, to take advantages of the facilities of marketing, skilled labour supply etc. Cooper, Batala and NSE treated the production

of machine tools as a side line only, while other companies are mainly engaged in the manufacture of machine tools.

Of the four companies in the private sector, NSE grew from a small workshop to the large scale unit, it is at present. The other three companies were started by managing agency groups which had already been established in the field of industry and commerce.

HMT and Praga, both public sector companies, have different patterns of growth. HMT was started with a fairly broader base of capital, practically unlimited financial resources and assured market for its products from the Government of India. Praga passed through many vicissitudes. Its struggle to come out of financial and technical difficulties continued long after it was taken over by the Government of India.

All the companies, during recent years, have tended to enter into collaboration agreements with foreign machine tool manufacturers, especially those from U.S.A., U.K., Western European countries and Japan. Technical collaboration agreements have also been entered into with a few manufacturers in Eastern European countries. The collaboration schemes have helped Indian companies to develop advanced types of machine tools. On the other hand, the tendency for going into collaboration agreements has discouraged the development of new designs by the manufacturers themselves. To quote Shri Venkatraman, member of the Planning Commission, "Most of us have a deepseated preference for imported

technology and we prefer to go to a foreign country for collaboration instead of exploring the same technology from within the country." ¹

All the six companies have their design and research departments, but serious efforts to build their own designs, have been made only by HMT and Mysore Kirloskar. Other companies have modified many of the imported designs, and in rare cases, have built some new designs.

The enterprisers who developed these companies can hardly be termed entrepreneurs as envisaged by Schumpeter, who were expected to undertake only the pioneering activities, such as a method of production not yet tested by experience in the branch of manufacture concerned, a product with which the consumers are not yet familiar, a new source of raw material or of new markets hitherto unexploited, or other innovations in the strict sense of the term.² The machine tool manufacturers in India tried to develop the products, the imports of which were threatened by the exigencies of the Second World War years. Even after the end of the War and during the Plan period, the manufacturers were mainly concerned in adapting the technology of advanced countries to the Indian conditions.

¹ Shri R. Venkatraman, Inaugural Address at the Twenty-first Annual General Meeting of the Indian Machine Tool Manufacturers' Association, Madras, January 22nd, 1968 (mimeographed). IMTMA, Bombay, p. 4.

² Joseph Schumpeter, The Theory of Economic Development. Translated by R. Opie. Harvard University Press, 1934, p. 66.

Nonetheless, these enterprisers performed several other important functions, such as the promotion of business and provision of capital, expansion of existing undertakings and risk bearing. In performing these activities, the indigenous machine tool builders were more or less successful. In the context of a concept of entrepreneurship in under-developed countries as given by the United Nations ^{Report,} / the Indian machine tool manufacturers have not done badly.¹

The histories of companies, however different in details, show their dependence on the nature of the machine tool demand. The companies developed rapidly during the War years, the Second Five Year Plan period and the early years of the Third Plan, when the market for machine tools was favourable for the machine tool builders. From 1964-65 onwards, the manufacturers are having a difficult time due to fall in demand. The attempts of a manufacturer to grow faster and larger are often conditioned by the extreme sensitivity of the machine tool industry to shifts in general economic environment.

A significant characteristic of machine tool factories is their rapid expansion during the recent years. Most of

1 "Entrepreneurship is a complex phenomenon involving numerous sub-functions; business promotion, capital provision and risk-bearing, technical innovation and adaptation and business management."

United Nations, Department of Economic and Social Affairs. Processes and Problems of Industrialisation in Underdeveloped Countries. New York: 1955, p. 30

the manufacturers have introduced advanced technology and installed in their shops advanced and costly machinery, but as far as the effective technical management of the plants is concerned, most of the manufacturers have been negligent in exploiting fully this costly equipment. This aspect of the utilization of capacity of machine tool factories is discussed in the next chapter.

CHAPTER 8UTILIZATION OF CAPACITY AND IMBALANCE OF CAPITAL
EQUIPMENT IN MACHINE TOOL FIRMS

In this chapter is studied the aspect of utilization of capacity in machine tool firms. This discussion leads to the necessity of conceptualizing a measure of capacity in multi-product firms (such as those manufacturing machine tools) and a measure of imbalance of capital equipment installed. The technique of Linear Programming is used to get the extent of capital imbalance and the utilization of capacity, by pointing out excess capacity per machine group (classified according to the operations). Such a study of excess capacity is important to provide guidelines for the policy of creating new capacity or expanding the already existing capacity of firms. The detailed case studies of two firms to study capital imbalance and excess capacity are followed by the general discussion of the need for increased capacity utilization.

Difficulties in Measuring Capacity
Utilization in a Multi-Product Firm

The degrees of utilization of the capacity of a firm can be indicated by the ratio of actual output within a specified period to the rated capacity output of that firm during that period. This rated capacity output is expressed as the

maximum possible output of a particular product or product-mix within a specified period, usually a month or a year, given the existing production equipment of the firm. The volume of capacity output of a firm is of a changing magnitude and is to be re-examined and determined at the end of every specified period.

To use the index of utilization of capacity given by the ratio of actual output to the capacity output, one encounters certain conceptual and practical difficulties.

The first sort of difficulty stems out of the difficulty of determining the capacity of a multi-product firm. In a uniprodukt firm like that of cement or sugar, the concept of capacity is well defined. If the raw material passes through from zero to n processes before becoming the final product, the minimum of these n processes will become the capacity of the firm. Here the unbalanced capital accumulation will be in those processes where the capacity is in excess of that of the process, which becomes a bottleneck.¹ However in a firm, which produces many products and where each product has to pass through several processes, the concept of total capacity is difficult to define. These processes are not necessarily of a sequential order. The fabrication of one product may need all the capacity of a

¹ R.S. Rao, Capacity Utilization in Sugar Industry in Maharashtra (A paper read at the Seminar in Input-Output Analysis, held in August 1965 at Gokhale Institute of Politics and Economics, Poona.)

particular process, while the other product may not undergo that process at all. In this case, the capacity of the firm has to be stated in terms of every product separately, e.g. in the case of a firm producing lathes, shapers and drills, the capacity would have to be stated that the factory is capable of producing m numbers of lathes, or p numbers of shapers or q numbers of drills. But the capacity in terms of a product-mix is not possible to state.

There were certain practical problems, apart from the difficulty of measurement of capacity, regarding the availability of relevant data. The data were easily available regarding sanctioned capacities, but it was not known whether actual installed capacity was equal to its sanctioned capacity. Estimates of rated capacity were obtained from the officials of the firms, also estimates were collected from the reports that were sent by the firms to various agencies of the government, (where the statement of rated capacity was required). At times, no capacity estimate of the firm was available, while in some other firm, some five or six estimates were presented by the officials and an equal number were obtained from the reports sent to various government agencies.

This inconsistency among the various estimates obtained from various officials and records of the same firm was a reason for the decision not to depend on the estimates thus collected. Moreover these estimates were either in value or

in terms of a particular product and not for all the items which were being manufactured. These data could not serve the purpose.

The Utilization of Capacity in Machine Tool Firms

Thus instead of taking the ratio of actual output to the capacity output, an indirect measure was used to assess the degree of utilization of capacity in seven machine tool firms studied, and fifteen firms answering the mailed questionnaire.

The plant utilization was arrived at as a dimensionless figure given by the ratio of total time booked for jobs on all machines to the total available time on all machines installed. The total available time is computed in the following way. Suppose a firm works for two shifts a day, with, say, ten machines, then the total available time for a day, for the ten machines installed, is $10 \times 8 \times 2 = 160$ hours, where a shift is assumed to be of 8 hours. The time is booked for jobs, involving various operations which a product passes through, on various machines. The total time booked for all the operations, for all the products planned to manufacture, on all the machines is the time booked on jobs.

The results of the twentytwo firms did not show a uniform pattern. HMT planned to-utilize 90 per cent of the total available time on all machines. Kirloskar aimed to

utilize 75 per cent of the total time. One firm was planning only for 32 per cent of the time available. The median figure for plant utilization was 56 per cent.

This, of course, does not mean that if the capacity of a unit is, say, 50 per cent, then every machine is used only for half the time. A certain machine may be used for all the time, while the other is not used at all. Thus to get a proper idea of capacity utilization, one has to find the capacity utilization of each machine. If a costly machine is not at all used, then it would cost the firm much more in terms of depreciation, rent etc. to keep that machine idle, than it would cost, if a cheap old machine is kept unutilized. Thus, it would be more meaningful to measure the excess capacity of each particular machine or machine group, which is unutilized. The measurement of the excess capacity with reference to a norm of optimum capacity, is discussed in following sections.

Excess Capacity and the Imbalance of Capital Equipment

Apart from the overall problem of utilization of capacity, there are aspects of excess capacity and the imbalance of capital equipment installed in the factory.

Every factory has a capacity and this capacity is in respect of the production of the final output within a specified period. Every type of machinery, which is an integral part of the plant, itself has a capacity. It is important to see that within each firm the individual machinery

capacities should be so adjusted that the under-utilization of machines is minimised. (This is not always possible because of the indivisibility of machines and certain factors like future expansion programmes. Thus to an extent the excess capacity is unavoidable.) It can be that in certain factories all the machinery is put to the full use and in certain other cases only some are being used fully to their capacity. Then in the former case, the increase in the final capacity of the factory can take place only with all the machinery capacities being increased. In the latter case, only the capacity of those machines that are providing a bottleneck for expansion, in the sense that they are already fully used, should be increased; or the excess capacity in these machine groups can be diminished by selling away some of the machines, or by doing part-time jobs for others.

The state of affairs where a few machine groups become bottlenecks and hinder the production, is termed as 'capital imbalance'. To measure the degree of capital imbalance and excess capacity, some norm regarding the capacity required for the optimum production which is possible with the equipment installed, needs to be found out. The deviation of the 'existing capacity' from the 'required capacity' needed for optimum production, can be termed as the excess capacity of the particular machine groups.

The Optimum Production Programme

A product is composed of a number of components which are fabricated on the machines installed in a machine tool

factory. A typical component, say a body, requires a number of machining operations such as turning, drilling, cutting plane surfaces, grinding etc. The capital equipment installed in the factory, can be grouped according to the operations they perform. For example, turning operations are performed on lathes, drilling operations on drilling machines, grinding operations on grinders and so on. The fabrication of one unit of the product requires the use of all or many of the machine groups according to the operations involved.

Suppose, there are n different groups of machines installed in the machine shop of a factory and that, m different products are produced. Now each of the final products requires in its fabrication, the use of several groups of machines for some specified amount of time on each machine group. These requirements are technologically determined. For the machines, which are not at all used in the fabrication of a particular product, the time requirement will be given as equal to zero. Thus with these n groups of machines and m products, $n \times m$ time coefficients will be available. The hours for which the machine group j has been engaged in the production of a single item of the product i can be defined as the time coefficient of the product i on the machine group j (a_{ij}).

Further, the total number of hours that each machine group can work for a specified time period (say, a year) is to be found out. To do this, it is necessary to know how many

shifts a day, the factory works. Many factories work on the three shift basis, some on two shifts and a few on one shift only. There are many technical and/or socio-economic reasons for this pattern. The demand for the products may not justify the factories working more than two shifts, or the management may not consider it worthwhile to work for more number of shifts, taking into consideration the increase in costs and profits resulting from working for an additional shift, and so on. For the best utilization of scarce capital resources of the country, it is necessary that conditions should be created, wherever possible; for the factories to work for three shifts a day. For the purposes of this study, however, the total hours available for the year are computed on the basis of shifts, the factory actually works for. If the index of utilization of capacity is computed on the three shift basis and the factory only works for two shifts, the utilization will be much too lower than what is indicated if we take into consideration the number of shifts actually worked.

Once the total number of hours available for each machine group and the time coefficients for each product on various machine groups are known, the problem is to programme the manufacture of different products in such a way as to maximise the total production or the total value added by the production, or the contribution to the overhead costs (Ex-factory price minus prime costs) according to the overall aims of the firm. This is a problem in Linear Programming where the total available hours for each machinery are the

constraints and the total production or the total value added or total contribution to the overhead costs is the maximising function. The maximisation of the total value added may be sought when decisions are taken for the benefit of the society as a whole, while the realization of the maximum contribution to overhead costs is more important to the owner of the factory.

The solution of this problem indicates the optimum production pattern. From this optimum production pattern, the utilization of each of the machine groups can be calculated by use of the time coefficients.

The Linear Programming Model

The algebraic expression of the Linear Programming maximising problem is stated as follows.

Suppose that a firm has k types of fixed resources (here the machine groups) in quantities of $S_1, S_2, S_3, \dots, S_k$ (expressed as the total machine hours available per each machine group) and n possible activities x_1, x_2, \dots, x_n (products) whose respective ex-factory prices or values added or contributions to the overhead costs, (depending on the objective function used) are v_1, v_2, \dots, v_n .

A production programme is specified with a set of activity levels x_1, x_2, \dots, x_n that fulfils the following requirements:

1) No activity level should be negative, i.e.,

$$0 \leq x_1, x_2, \dots, x_n.$$

- 2) No more than the available supply of fixed resources is required, i.e.,

$$a_{11}x_1 + a_{21}x_2 + \dots + a_{n1}x_n \leq S_1$$

$$a_{12}x_1 + a_{22}x_2 + \dots + a_{n2}x_n \leq S_2$$

$$a_{13}x_1 + a_{23}x_2 + \dots + a_{n3}x_n \leq S_3$$

$$\dots$$

$$\dots$$

$$\dots$$

$$a_{1k}x_1 + a_{2k}x_2 + \dots + a_{nk}x_n \leq S_k$$

where a_{ij} is the number of units of the j th resource used by one unit of the i th activity.

- 3) The total production, or value added, or contribution to overhead costs resulting from any programme vector $X = (x_1, x_2, \dots, x_n)$ is

$$r = v_1x_1 + v_2x_2 + \dots + v_nx_n$$

where v_1, v_2, \dots, v_n are the ex-factory prices or values added, or contributions to overhead cost, of the activities x_1, x_2, \dots, x_n respectively.

The allocation problem is to find a programme vector X , that satisfies the requirements 1 and 2, and makes r as great as possible.

Imbalance of Capital Equipment and Its Measurement

If the capital equipment policy had been followed in such a way that there was no excess capacity for any of the machine groups, it should have been possible to utilize all

the machines to their fullest capacity while producing in accordance with the optimum production pattern. In such circumstances we may say that the coefficient of imbalance of capital equipment installed in the factory is zero. However, in practice, it may be found that some machines remain more or less unutilized while working on such an optimum production pattern.

The extent of this excess capacity can be calculated in the following way.

S_j :- Total available machine hours of the resource j

$S'_j = \sum_{i=1}^n a_{ij}x_n$:- Machine hours used by the products in the optimum pattern, of the resource j

The difference between the total available hours on a particular machine group and the hours utilized on the same to produce the optimum production, indicates the excess capacity for that particular machine group. ($S_j - S'_j =$ Excess Capacity.)

To get an overall idea of the imbalance of the capital equipment, a suitable weighted average of this excess capacity can be taken. Weights may be taken up in proportion to the cost (represented by the book value) of each machine group. This weighted average will indicate the coefficient of imbalance of the capital equipment of a particular firm. This coefficient will be zero when all the machines are

completely utilized for producing the output indicated by the optimum production pattern. It will be unity when no output is produced, and all the machines remain idle for all the time during a specified time period.

Optimum Capacity

The application of the Linear Programming Technique to the operations of the factory, indicates the optimum capacity (given by the optimum output which is capable of being produced,) given the capital equipment installed, time coefficients and maximum hours available on each machine group.

The ratio of the actual output to the optimum capacity output indicates the utilisation of the capacity of the firm.

The utilisation ratio can also be had by comparing optimum value added to the actual value added; or optimum contribution to the overhead costs to the actual contribution, depending on the objective function used. By taking the index of capacity utilisation and that of capital imbalance into consideration, one can form a fair impression of the operations of the factory.

Empirical Results

The Linear Programming Technique was applied to the data made available by two firms. These firms were manufacturing shaping machines, lathes, drilling machines, slotters, turrets and planers. Out of the two main production departments of a typical machine tool firm, viz., the machine shop

and the assembly, only the operations of the former are considered. Processes in the assembly such as fitting, scrapping, etc., mainly require the use of skilled labour and do not need costly equipment such as compared to that installed in the machine shop. Thus for purposes of the study of unbalanced structure of the capital equipment, the assembly processes are ignored, with the assumption that the required number of skilled workers can be available for any level of production. Similarly, the processes in the foundry are ignored. In India, it is typical of a machine tool firm to have its own foundry attached to it. These foundries also take orders from outside manufacturers, in addition to catering for the requirements of their own machine tool factories. Thus, it becomes difficult to assess the capacity of the foundry for machine tool building only.

The capital equipment in the machine shop is classified according to the six basic processes involved in the fabrication of components of a product. These are: (a) turning, (b) drilling and boring, (c) milling, (d) shaping and planing, (e) grinding, (f) forging. The last mentioned operation was not used in the fabrication of the product, as the firms used metal cutting machine tools only.

These broad classes can be further disaggregated. For example, the lathes on which turning operations are performed, can be further classified according to the size and the capacity. A job of big size cannot be attempted on a lathe which has capacity only for a smaller job. Similar is the

case with milling machines, planers, shaping machines, etc. There are two qualifications regarding disaggregation. A very broad group assumes perfect substitutability of operations among the machines comprising the group. It is not so. Similarly, the disaggregation cannot be carried too far, as it would mean that there is no substitutability among machines of different sub-groups. It is not so, as there does exist a degree of substitutability between machines not very dissimilar regarding size and capacity. Thus, a fine balance between one broad group and many sub-groups has to be maintained keeping in view the substitutability of machines within the group for similar operations. Finally, for practical purposes, the decisions regarding the classification are dependent on the availability of data.

Because machines performing a similar operation (e.g. lathes performing turning operation) are brought under one group, another limitation has crept in. The substitution possibilities among the groups have been ignored. For example, a turning operation can be performed on a lathe as well as on a milling machine. The scope for such substitution possibilities is, however, limited. In addition, the production planning department of the respective firms are supposed to have arrived at the best possible choice of the machine for a particular job, after taking into consideration the size of the component to be fabricated, the tensile strength and brinell hardness of the material used and the capacity of the

machine on which operation has to be performed. In this respect, we are guided by the choice of the production planning department. Nevertheless, a situation can be visualised where, if sufficient machine hours for a particular operation are not available on a particular machine at a particular time, which is the best choice, the other machine, the next best choice, belonging to a different group is employed.

The model does not take into consideration the fact, that the machine tools are manufactured on the principle of batch quantity. Thus, if economic batch quantity is say 50 items and the optimum output happens to be 613 items, the 13 items do not form the economic batch quantity and the production of the same is technically undesirable. However, the technically determined batch quantity is not fixed for a complete unit of a product but differs from component to component comprising that product. The practical difficulties, such as, a single product comprising of, say, from five hundred to thousand components, the inadequate capacity of the computer on which such a model has to be solved, make one disregard the fact of batch quantity production.

The model does not take into account sequence dislocations and assumes a continuous process of production according to a predetermined schedule of operations. The set-up time for the jobs is included in the machine-hour inputs, but the time lost due to other causes e.g. fatigue, rest, etc. is not included.

The efficiency of the worker differs from factory to factory and among various grades in the same factory; depending on the type of equipment used, the experience of the worker etc. The production planning department first arrives at the standard machine hours required for a particular job, on the basis of theoretical calculations, and then modifies them accordingly, taking into consideration experience and efficiency of the worker, the age and efficiency of the machine used etc. Nevertheless, in so far the standard machine hours are used to decide the mode of incentive payment, it is natural that the calculation of standard machine hours forms an issue of controversy between the management and workers.

The maximum available hours on each group of machines are arrived at a two-shift basis for the Firm A and on the three-shift basis for the Firm B. These maximum available hours represent the total rated capacity of the factory, expressed in machine-hours.

The objective functions to be maximised are as follows:

- (a) Production (Ex-factory price of the product)
- (b) Value added (Ex-factory price of the product minus the cost of the materials and direct manufacturing costs)
- (c) The contribution to the overhead costs (Ex-factory price minus prime costs viz., materials, direct manufacturing costs and direct labour).

The data for the Linear Programming Model for Firm A and Firm B are given in Tables 8.1 and 8.2 respectively.

The optimum production plans for various objective functions and the coefficients of capital imbalance are as presented in Table 8.3.

The solution of the Linear Programming Problems also gives values in rupees for optimum production, optimum value added and optimum contribution to the overhead costs, as shown in the Table 8.4.

For the Firm A, two sets of solutions were found. The solution (a) does not take into account the limitations imposed by the demand and other considerations in the market, and assumes that whatever is produced, can be sold.

The solution (b) has taken into consideration the upper limits to which the production can be sold in the market. These are exogeneous restraints arrived at by the firm after taking into consideration the past sales and future demand for the products. Such judgments are necessarily educated guesses. The firms do not themselves conduct intensive market surveys and normally depend on their own hunches and the advice of their selling agents to form expectations about the possible demand. The two solutions (one without and one with market restraints), however, do not show wide variations. The solution (a) with market restraints indicates that the levels of products 3 and 4 reach the maximum limits upto which the products can be sold. Thus greater efforts regarding sales for these products may prove to be advantageous.

Table 8.1 : Data for Linear Programming Model

Machine Group	Firm A					(Time in hours) Maximum Available Hours
	Products					
	1	2	3	4	5	
1. Centre Lathes	67.85	79.45	55.98	24.85	87.66	116,250
2. Capstan Lathes	75.98	49.85	91.51	63.63	36.03	55,800
3. Turret Lathes	8.41	0.50	1.56	12.03	0.90	13,950
4. Horizontal Milling	12.10	8.08	8.11	8.70	13.31	18,600
5. Vertical Milling	32.71	19.88	12.52	17.21	21.61	27,900
6. Key-way Milling	3.40	6.41	11.43	1.73	3.96	13,950
7. Thread Milling	14.30	5.60	4.11	0.00	6.20	23,250
8. Pillar Drilling	5.15	4.81	2.86	0.66	7.96	18,600
9. Radial Drilling	21.71	40.30	27.28	16.55	18.73	51,150
10. Horizontal Boring upto 100 mm.	11.00	10.75	12.75	6.80	2.40	18,600
11. Horizontal Boring BFT-125	0.00	0.00	24.00	3.50	0.00	4,650
12. Vertical Boring (Stirk)	6.30	3.58	2.50	2.00	1.33	4,650
13. Vertical Boring (Bullard)	3.41	2.48	2.00	1.50	3.83	4,650
14. Jig Mill 2B-36	2.50	2.00	21.58	0.00	4.16	4,650
15. Jig Mill 3H-48	5.00	5.00	0.00	8.00	10.66	4,650
16. Cylindrical Grinding upto 150x750	21.03	18.40	23.40	9.21	21.03	13,950
17. Cylindrical Grinding (Column)	0.00	0.00	7.00	5.30	2.66	4,650
18. Internal Grinding	9.50	9.86	6.30	3.26	6.33	32,550
19. Surface Grinding (Reciprocating)	15.76	8.88	11.31	1.96	7.95	13,950
20. Surface Grinding (Rotary)	4.11	2.63	0.00	0.00	0.00	9,300
21. Guideway Grinding	7.00	6.00	5.00	0.00	2.50	13,950
22. Gear Grinding	8.10	17.83	6.35	6.11	5.41	18,600
23. Spline Grinding	5.05	3.10	5.05	3.33	2.70	9,300
24. Shaping	12.71	11.51	7.98	2.50	16.56	13,950
25. Slotting	0.00	0.75	1.16	1.06	7.73	4,650
26. Planing	35.12	33.00	24.83	7.66	7.00	32,550
27. Gear Cutting	16.01	20.40	10.85	9.86	9.71	37,200
28. Broaching	6.10	7.40	5.30	3.05	5.18	4,650
29. Market	0.00	0.00	1.00	0.00	0.00	70
30. Restraints	0.00	0.00	0.00	1.00	0.00	100
31.	0.00	0.00	0.00	0.00	1.00	50

1) Maximum Production

$$r_1 = 20700x_1 + 15530x_2 + 24050x_3 + 10875x_4 + 10875x_5$$

2) Maximum Value Added

$$r_2 = 15542x_1 + 8562x_2 + 16562x_3 + 7175x_4 + 6302x_5$$

3) Maximum Contribution to Overhead Costs

$$r_3 = 11611x_1 + 7747x_2 + 15677x_3 + 6787x_4 + 5780x_5$$

Table 8.2 : Data for Linear Programming Model

Machine Group	<u>Firm B</u>								Total available hours
	Products								
	1	2	3	4	5	6	7	8	
1. Planing	39	50	75	101	92	68	535	620	48,300
2. Horizontal Boring	22	58	87	318	70	154	250	300	48,300
3. Vertical Boring	11	13	20	94	87	38	76	110	13,800
4. Horizontal Milling	12	49	73	85	60	50	150	200	20,700
5. Vertical Milling	35	49	73	172	115	100	30	50	41,400
6. Shaping	20	5	7	241	142	118	60	60	55,200
7. Gear Hobbing	4	7	10	39	21	21	50	97	13,800
8. Heavy Duty Turret	10	85	127	162	57	56	150	200	13,800
9. Heavy and Medium Centre Lathes	36	118	177	269	186	141	100	100	48,300
10. Light Centre Lathes	6	0	0	75	52	42	12	75	13,800
11. Capstan	16	0	0	72	104	47	9	25	6,900
12. Key-way Slotter	2	15	22	25	24	18	70	53	13,800
13. Cylindrical Grinder	3	1	2	42	24	23	0	0	6,900
14. Internal Grinder	3	14	21	0	0	13	0	0	6,900
15. Surface Grinder	5	18	27	21	15	8	0	0	6,900
16. Sensitive Drilling	6	18	27	11	8	40	68	68	13,800
17. Radial Drilling	10	53	78	57	42	0	183	173	27,600

Objective Functions1. Maximum Production

$$r_1 = 4101x_1 + 9325x_2 + 16650x_3 + 17781x_4 + 14818x_5 + 12340x_6 + 35507x_7 + 52722x_8$$

2. Maximum Value Added

$$r_2 = 3489x_1 + 4302x_2 + 16272x_3 + 15244x_4 + 12704x_5 + 10691x_6 + 31802x_7 + 47355x_8$$

3. Maximum contribution to overhead costs

$$r_3 = 2943x_1 + 2706x_2 + 15412x_3 + 13776x_4 + 11481x_5 + 9791x_6 + 23087x_7 + 32250x_8$$

Table 8.3 : Optimum Production Plans for Machine Tool Firms

Objective Function	Products	Level of Production (Nos.)	Coefficient of Capital Imbalance
--------------------	----------	----------------------------	----------------------------------

FIRM (A)**(a) Without Market Restraint**

I) Maximum Production	}	1	416	}	0.4979
Maximum contribution to overhead costs		3	167		
		4	139		
II) Maximum Value Added	}	1	585	}	0.5013
		4	178		

(b) With Market Restraints

I) Maximum Production	}	1	542	}	0.4987
Maximum contribution to overhead costs		3	70		
		4	100		
II) Maximum Value Added	}	1	620	}	0.5052
		4	100		

FIRM (B) (Without Market Restraints)

I) Maximum Production	}	1	351	}	0.3408
Maximum Value Added		8	46		
Maximum contribution to overhead costs					

Source : Solutions to the Linear Programming Problems.

Table 8.4 : Optimum Production, Optimum Value Added and Optimum Contribution to Overhead Costs

	Optimum production (Rs.)	Optimum value added (Rs.)	Optimum con- tribution to overhead costs (Rs.)
Firm A			
i) Without market restraints	1,41,53,650	1,03,75,139	84,00,672
ii) With market restraints	1,39,83,253	1,03,46,445	80,65,243
Firm B			
	41,51,774	36,60,883	26,92,053

Source : Solutions to the Linear Programming Problems.

Not all the products find themselves in the optimum programmes. In the case of Firm B, only 2 products out of 8 have entered the optimum programme. The optimum plans indicate to what extent the product diversification is becoming uneconomic to the firms. Concentrating on a few products, the firm can increase their efficiency in capacity utilization. Also, they can show a better financial performance. The practical difficulties in the way of such an action, however, should be noted. The demand for various types of machine tools fluctuates from time to time. Hence a typical machine tool manufacturer establishes himself in the manufacture of various products of different sizes and

capacities. He has to see that if for any reasons, the demand for a particular product does not generate, he has already other products at hand, for which the demand is not likely to fall. The fluctuations in demand seem to persuade the manufacturer to lean on safe side and to make his position safe by resorting to product diversification.

The way in which the coefficients of capital imbalance for Firm A and Firm B are computed, is shown in Tables 8.5 and 8.6 respectively. This calculation is done in detail only for one objective function for Firm A. In other cases only the results regarding the proportion of unutilized hours to the total available hours and the cost of unutilized capacity are presented.

The degree of capital imbalance and the excess capacity per machine group is quite of a substantial amount. The policy of purchasing capital equipment will have to be given a new look. At the face of it, the degree of excess capacity suggests that either the capacity of machine groups which are becoming bottlenecks should be increased or the excess capacity in certain machine groups could be reduced without affecting the operations of the firm.

Utilization of Capacity with reference to the Optimum Production

The utilization of capacity of the two firms studied can also be expressed as a ratio of actual output to optimum output. These ratios are given in Table 8.7.

Table 8.5 : Excess Capacity and Capital Imbalance

Firm A (Without Market Restraints)

Objective Function : 1) Maximum Production
3) Maximum Contribution to Overhead Costs

Firm A (Without Market Restraints)

Objective Function : Maximum Value
Added

Machine Group	I Book Value of Capital Equipment Gross	II Total Available Hours	III Hours Utilized $\sum_{j=1}^n a_{ij}x_j = S_i$	IV=(II-III) Hours Unutilized	V=(IV/II) Ratio of Unutilized Hours to Total Available Hours	VI=(IxV) Cost of Unutilized Capital	VII Ratio of Unutilized Hours to Total Available Hours	VIII Cost of Unutilized Capital
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Centre Lathe	323,923	116,250	13,111.88	103,138.12	0.8872	287,384.49	0.6203	200,929.44
2. Capstan	338,251	55,800	55,799.27	0.73	0.000013	10.49	0.0000	0.00
3. Turret	133,638	13,950	5,438.64	8,511.36	0.6101	81,532.54	0.4937	65,977.08
4. Horizontal Milling	204,269	18,600	7,605.29	10,994.71	0.5911	120,743.41	0.5359	109,467.76
5. Vertical Milling	200,764	27,900	18,106.45	9,793.55	0.3510	70,468.16	0.2039	40,935.78
6. Key-way Milling	25,746	13,950	3,568.06	10,381.94	0.7442	19,160.17	0.8353	21,505.63
7. Thread Milling	421,132	23,250	6,638.14	16,611.86	0.7145	300,898.81	0.6399	269,482.37
8. Pillar Drilling	22,825	18,600	2,713.52	15,886.48	0.8541	19,494.83	0.8316	18,981.27
9. Radial Drilling	216,912	51,150	18,402.65	32,747.35	0.6402	138,867.06	0.6253	135,635.07
10. Horizontal Boring upto 100 mm.	351,744	18,600	7,658.65	10,941.35	0.5882	206,895.82	0.5888	207,106.87
11. Horizontal Boring BFT-125	335,028	4,650	4,502.70	147.30	0.0317	10,620.39	0.8661	290,167.75
12. Vertical Boring (Stirk)	31,640	4,650	3,318.78	1,331.22	0.2863	9,058.53	0.1303	4,122.69
13. Vertical Boring (Bullard)	19,775	4,650	1,962.78	2,687.22	0.5779	11,427.97	0.5133	10,150.51
14. Jig Milling 2B-36	268,263	4,650	4,650.02	0.00	0.0000	0.00	0.6852	183,813.81
15. Jig Milling 3H-48	377,899	4,650	3,196.57	1,453.43	0.3126	118,131.23	0.0645	24,374.49
16. Cylindrical Grinding upto 150 x 750	85,984	13,950	13,950.03	0.00	0.0000	0.00	0.0000	0.00

(continued)

Table 8.5 : (continued)

Machine Group	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
17. Cylindrical Grinding Column Grinding	67,456	4,650	1,910.19	2,739.81	0.5892	39,745.08	0.7973	53,782.67
18. Internal Grinding	563,655	32,550	5,462.78	27,087.22	0.8322	469,073.69	0.8113	457,293.30
19. Surface Grinding - Reciprocating	161,476	13,950	8,723.43	5,226.57	0.3747	60,505.06	0.3136	50,638.87
20. Surface Grinding - Rotary	119,864	9,300	1,710.29	7,589.71	0.8161	97,821.01	0.7413	88,855.18
21. Guideway Grinding	599,815	13,950	3,749.26	12,200.74	0.7312	438,584.73	0.6072	423,589.35
22. Gear Grinding	359,172	18,600	5,285.09	13,314.91	0.7159	257,131.23	0.6866	246,607.50
23. Spline Grinding	25,758	9,300	3,410.67	5,889.33	0.6333	16,312.54	0.6184	15,928.75
24. Shaping	76,564	13,950	6,972.55	6,977.45	0.5002	38,297.31	0.4347	33,282.37
25. Slotting	5,650	4,650	341.89	4,308.11	0.9264	5,234.16	0.9594	5,420.61
26. Planing	1,678,738	32,550	19,836.29	12,713.71	0.3906	655,715.06	0.3265	548,107.96
27. Gear Cutting	158,303	37,200	9,852.49	27,347.51	0.7351	116,368.54	0.7009	110,954.57
28. Broaching	52,824	4,650	3,850.36	799.64	0.1720	9,085.73	0.1153	6,090.61
Total	7,227,068					3,598,568.04		3,623,202.26

Therefore

The Coefficient
of Capital
Imbalance

$$= \frac{3598568.04}{7227068}$$

$$= 0.4979$$

Therefore

The Coefficient
of Capital
Imbalance

$$= \frac{3623202.26}{7227068}$$

$$= 0.5013$$

(continued)

Table 8.5 : (continued)

Firm A : (With Market Restraints)

Objective Functions:

- 1. Maximum Production
- 3. Maximum Contribution to Overhead Costs

Objective Function:

- 2. Maximum Value Added

Machine Group	I Book Value of Capital Equipment (Gross)	II Ratio of unutili- zed hours to total available hours	III=(IxII) Cost of Unutilized Capital	IV Ratio of unutili- zed hours to total available hours	V=(IxIV) Cost of Unutilized Capital
1. Centre Lathes	323,923	0.6287	203,650.39	0.6168	199,795.71
2. Capstan Lathes	338,251	0.0332	11,229.93	0.0418	14,138.89
3. Turret Lathes	133,638	0.5792	77,403.13	0.5400	72,164.52
4. Horizontal Milling	204,269	0.5701	116,453.76	0.5499	112,327.52
5. Vertical Milling	200,764	0.2715	54,507.43	0.2114	42,441.51
6. Key-way Milling	25,746	0.7981	20,547.88	0.8365	21,536.53
7. Thread Milling	421,132	0.6543	275,546.67	0.6187	260,554.37
8. Pillar Drilling	22,825	0.8356	19,072.57	0.8248	18,826.06
9. Radial Drilling	216,912	0.6369	138,151.25	0.6249	135,765.22
10. Horizontal Boring upto 100 mm.	351,744	0.5949	209,252.51	0.5968	209,217.33
11. Horizontal Boring BFT-125	335,028	0.5634	188,754.78	0.9248	309,833.89
12. Vertical Boring - Stirk	31,640	0.1850	5,853.40	0.1170	3,701.88
13. Vertical Boring - Bullard	19,775	0.5402	10,682.46	0.5131	10,146.55
14. Jig Milling 2B-36	268,263	0.3837	102,932.51	0.6667	178,350.94
15. Jig Milling 3H-48	377,899	0.2452	92,660.83	0.1613	60,955.11
16. Cylindrical Grinding upto 150x750	85,984	0.0000	00,000.00	0.0000	00,000.00
17. Cylindrical Grinding Column Grinding	67,456	0.7806	52,656.15	0.8860	59,776.02
18. Internal Grinding	563,655	0.8182	461,182.52	0.8090	455,996.90
19. Surface Grinding - Reciprocating	161,476	0.3169	51,171.74	0.2855	46,101.40
20. Surface Grinding - Rotary	119,864	0.7605	91,156.57	0.7260	87,021.26
21. Guideway Grinding	599,815	0.7029	421,609.96	0.6889	413,212.55
22. Gear Grinding	359,172	0.7072	254,006.44	0.6972	250,414.72
23. Spline Grinding	25,758	0.6319	16,276.48	0.6275	16,163.15
24. Shaping	76,564	0.4482	34,315.98	0.4172	31,942.50
25. Slotting	5,650	0.9597	5,422.31	0.9772	5,521.18
26. Planing	1,678,738	0.3383	567,917.07	0.3075	516,211.94
27. Gear Cutting	158,303	0.7198	113,946.50	0.7067	111,872.73
28. Broaching	52,824	0.1436	7,585.83	0.1211	6,396.99
	<u>7,227,068</u>		<u>3,603,946.75</u>		<u>3,650,877.37</u>
	Coefficient Capital Imbalance	= $\frac{3603946.75}{7227068}$		Coefficient Capital Imbalance	= $\frac{3650877.37}{7227068}$
		= 0.4987			= 0.5052

Table 8.6 : Excess Capacity and Capital ImbalanceFirm BObjective Functions

1. Maximum Production
2. Maximum Value Added
3. Maximum Contribution to Overhead Costs

Machine-Group	I Book value of Capital Equip- ment Gross (Rs.)	II Proportion of Unutilized hours to total available hours	III (I x II) Cost of Un- utilized Capital Equipment (Rs.)
1. Planing	1,323,902	0.0561	74,270.90
2. Horizontal Boring	560,339	0.5206	291,712.48
3. Vertical Boring	679,994	0.3101	210,866.14
4. Horizontal Milling	117,521	0.2994	35,185.79
5. Vertical Milling	303,328	0.6412	194,493.91
6. Shaping	101,661	0.8169	83,046.87
7. Gear Hobbing	97,578	0.5366	52,360.35
8. Heavy Duty Turret	208,671	0.0000	0000000.00
9. Heavy and Medium Centre Lathes	238,120	0.6320	150,491.84
10. Light Centre Lathes	21,370	0.5678	12,133.89
11. Capstan	61,919	0.0000	0000000.00
12. Slotting	34,142	0.7515	25,657.71
13. Cylindrical Grinding	81,838	0.8415	69,357.71
14. Internal Grinding	129,454	0.8475	109,712.27
15. Surface Grinding	28,750	0.7458	21,441.75
16. Sensitive Drilling	8,034	0.5938	4,770.59
17. Radial Drilling	125,938	0.5503	69,303.68
	4,122,555		1,404,805.88

Therefore the Coefficient
of Capital Imbalance = $\frac{1404805.88}{4122555.00}$
= 0.3408

Table 8.7 : Utilization of Capacity in Firm A and Firm B

	Actual output (Rs.)	Optimum output (Rs.)	I/II %
	I	II	III
<u>Firm A</u>			
1) Without market restraints	74,61,000	1,41,53,650	52.7
ii) With market restraints	74,61,000	1,39,83,253	53.4
<u>Firm B</u>	26,13,060	41,51,774	62.9

It appears that only about half of the optimum capacity of the Firm A and capacity of the Firm B is utilised. These ratios, considered along with the coefficients of capital imbalance of the firms, indicate that a large part of the capacity is left unutilized.

An idea regarding the extent of overall utilization of capacity in machine tool firms can also be had from the data regarding installed capacity and actual output for all the machine tool manufacturing firms in India. These data as compiled from the volumes of Monthly Statistics of Production of Selection Industries of India are presented in Table 8.8.

During all the years since 1963 the capacity of the machine tool manufacturing firms for producing machine tools

has exceeded the production. The extent of unutilised capacity is greater during the years 1965, 1966 and July 1967 and this is due mainly to the state of recession in industries sector and consequent lack of demand.

Table 8.8 : Capacity and Production of Machine Tool Firms: Monthly Average (Rupees in Thousands)

Year	Installed capacity Machine Tools (Rs.)	Production Machine Tools (Rs.)	Utilisation (III/II)
(I)	(II)	(III)	(IV)
1963	1,58,11.0	1,49,88.7	94.8 per cent
1964	2,00,46.0	1,97,84.3	98.6 per cent
1965	3,11,42.0	2,37,46.0	76.3 per cent
1966	3,48,45.0	2,82,90.0	81.2 per cent
July 1967	4,10,00.0	2,30,18.0	56.1 per cent

Source : Government of India, Central Statistical Organization (Industrial Statistics Wing), Calcutta: Monthly Statistics of the Production of Selected Industries of India, March-April 1966, July-August 1967.

Nevertheless, the conversations with the officials of the firms studied and answers to mailed questionnaires indicate that the extent of unutilized capacity may be much greater for years 1963 and 1964 and also for subsequent years than what is reflected in the data presented in the table. It is not known on what basis the capacity of the machine tool firms is indicated. The Monthly Statistics only states that the

statistics were obtained from the office of the Director General of Technical Development, New Delhi, which in turn estimated the monthly production from returns received from occupiers of factories, and the installed capacity was estimated assuming 300 days of one shift working.¹ The major machine tool firms accounting for bulk of the production, work for two or sometimes three shifts a day, though many smaller firms, with machine tool production only as a side line are working only for one shift a day. Thus evidently, installed capacity being computed on the one shift basis, the published figure for installed capacity is considerably under-estimated, while the production is for the actual number of shifts worked.

In fact, a doubt can be expressed on the method of estimating installed capacity, which is highly flexible and difficult to measure for a multi-product firm with an equipment capable of producing alternative products of an allied nature. From the talks with the officials of major factories, it was seen that capacity is differently estimated in individual factories and is largely a matter of individual opinion. Thus one may dare to call the method of estimating installed capacities from the returns sent in by factories, as no more than an opinion survey.

¹ Government of India, Central Statistical Organisation (Industrial Statistics Wing): Monthly Statistics of the Production of Selected Industries of India for July-August 1967, p. 111.

Dual Problem

The method of finding the optimal production programme for a firm, though initially strictly mathematical in form, really depended on an economic criterion, that no product should be manufactured if a more profitable product or a combination of products was available to the firm.

This method can do more than find an optimal production programme. The method implies values to be placed on various scarce resources (here, the machine groups). If we have the maximum production with any list of machine-groups, except that the quantity of machine hours available on one group has been increased by one hour, the second problem may yield a greater value given by that extra hour. Thus a Linear Programming Technique implies a cost to be imputed to each additional machine hour of each of the machine groups. This imputed cost may, for the sake of convenience, be said to include the depreciation, maintenance, and interest charges for the use of one additional hour on the machine group.

Thus, the valuation problem analogous to the allocation problem can be formulated. Instead of a set of product levels, we seek a set of values u_1, u_2, \dots, u_k . (u_1 is the imputed cost of one hour of S_1 , u_2 that of one hour of S_2 etc.)

Constraints

1) No machine hour cost is negative, i.e.,

$$0 \leq u_1, u_2, \dots, u_k$$

2) The imputed cost of the total machine hours consumed by one unit of the product is at least as great as the ex-factory price per one unit of the product, (according to marginal cost = marginal revenue) under perfect competitive conditions, i.e.,

$$a_{11}u_1 + a_{12}u_2 + \dots + a_{1k}u_k \geq v_1$$

$$a_{21}u_1 + a_{22}u_2 + \dots + a_{2k}u_k \geq v_2$$

$$\dots$$

$$a_{n1}u_1 + a_{n2}u_2 + \dots + a_{nk}u_k \geq v_n$$

where v_1, v_2, \dots, v_n are ex-factory prices realisable from products x_1, x_2, \dots, x_n respectively.

a_{ij} - the number of hours of the j th machine group used by one unit of the i th product.

3) The aggregate cost of all the additional hours of the machine groups is

$$r' = S_1u_1 + S_2u_2 + \dots + S_ku_k$$

The dual problem is to find out a set of values (u_1, u_2, \dots, u_k), which minimises r' .

It is not necessary to solve the dual problem in the above form. According to the dualism of pricing and allocation, if we solve the Linear Programming Maximising Problem, we obtain as by-products, the marginal productivity costs of the one hour of each of the machine group.

Thus, if x_1 , the level of i th product, is positive, then the machine hours used in the manufacture of the product valued at marginal productivity will exactly absorb the ex-factory price, i.e.,

$$v_1 = w_1 = a_{11}u_1 + a_{12}u_2 + \dots + a_{1k}u_k$$

(w_1 - the total cost of machine hours consumed in the production of x_1 .)

If k products actually occur in the optimal programme, then we get k linear equations for determining the k unknowns, u_1, u_2, \dots, u_k from the known values of v_1, v_2, \dots, v_k .

The solutions of the simultaneous equations, giving the answers to the dual problems of Firm A and Firm B are shown in Tables 8.9 and 8.10 respectively. The values thus obtain represent the imputed costs of the additional hours on the scarce resources. The solutions, thus obtained, are mainly of an academic interest, as the scarce resource (machine group, or an individual machine) is indivisible one.

Causes of Under-utilization of Capacity, and Capital Imbalance

The detailed data required to formulate the Linear Programming Problems to establish the fact of under-utilization of capacity and capital imbalance was not available from other firms. But the conversations with the officials of many firms have led the author to think that the situation may not be much different in other firms in this respect.

Table 8.9 : Dual Problem - Without Market RestraintsFirm AI. Objective Function - Maximum ProductionOptimal Products : $x_1 = 416.13$ $x_3 = 167.27$ $x_4 = 139.49$

Resources fully used : Max.

u_1	- 2 Capstan	(55,800 total machine hours available)
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u_2	- 14 Jig Milling	(4,650 total machine hours available)
-------	------------------	--

u_3	- 16 Cylindrical Grinding	(13,950 Total machine hours available)
-------	---------------------------	--

Therefore, the dual problem:

$$75.98u_1 + 2.50u_2 + 21.03u_3 = 20700 \quad \dots (1)$$

$$91.51u_1 + 21.58u_2 + 23.40u_3 = 24050 \quad \dots (2)$$

$$63.63u_1 + 0.00u_2 + 9.21u_3 = 10875 \quad \dots (3)$$

To minimise :

$$Z = 55800u_1 + 4650u_2 + 13950u_3$$

Solving equations 1, 2, and 3, we get :

$$u_1 = 60.75$$

$$u_2 = 31.56$$

$$u_3 = 761.07$$

(continued)

Table 8.9 : (continued)

Dual Problem - With Market Restraints

Firm AI. Objective Function - Optimum ProductionOptimal Products : $x_1 = 542$ $x_3 = 70$ $x_4 = 100$

Resources fully used :

 u_1 - 16 Cylindrical Grinding (13,950 total machine hours available) u_2 - 29 Market restraint for x_3 (70 maximum saleable quantity) u_3 - 30 Market restraint for x_4 (100 maximum saleable quantity)

Therefore, the dual problem:

$$21.03u_1 + 0.00u_2 + 0.00u_3 = 20700 \quad \dots (1)$$

$$23.40u_1 + 1.00u_2 + 0.00u_3 = 24050 \quad \dots (2)$$

$$9.21u_1 + 0.00u_2 + 1.00u_3 = 10875 \quad \dots (3)$$

To minimise:

$$Z = 13950u_1 + 70u_2 + 100u_3$$

Solving equations 1, 2, and 3, we get :

$$u_1 = 984.31$$

$$u_2 = 1017.15$$

$$u_3 = 1809.50$$

Table 8.10 : Dual ProblemFirm BObjective Function - Maximum Production

In the optimal solution, we have,

Products : (1) and (8)

Resources fully used:

u_1 - 8 Heavy duty turret (13,800 maximum machine hours available)

u_2 - 11 Capstan (6,900 maximum machine hours available)

Therefore, the dual problem:

$$10u_1 + 16u_2 = 4101 \quad \dots (1)$$

$$200u_1 + 25u_2 = 52722 \quad \dots (2)$$

To minimise:

$$Z = 13800u_1 + 6900u_2$$

After solving the equations (1) and (2), we get:

$$u_1 = 251.19$$

$$\text{and } u_2 = -99.32$$

An attempt to probe into the reasons behind the fact of unutilized capacity revealed two strands of thinking. According to the first, the officials of the firms were apologetic about the under-utilization of the capacity of the plant and attributed its cause to certain policies of the government affecting the supply of enough raw materials, supply of imported components etc. They thought that, to a certain extent, there was a lack of demand for their products. The under-utilization of capacity is also supposed to be due to the inefficiency of labour or recurrent labour troubles.

There have been repeated references in the Annual Reports of the Indian Machine Tool Manufacturers' Association regarding the shortages of key raw materials, such as pig-iron, coal and alloy steels. Similarly, the difficulties of foreign exchange affect the supply position of imported components and materials. Nevertheless, the shortage of materials is difficult to prove in the case of individual firms, if the size of inventories of raw materials with the individual firms is to be any guide (as can be seen by the magnitude of the inventory coefficients given in Chapter 3).

The position of raw materials availability is steadily improving in recent years. In fact, during 1966-67, there were not enough orders from manufacturers for alloy steel of the grade EN-24, made available by the Hindustan Steel Limited, Alloy Steel Division, Durgapur.¹ The problems of under-

¹ Interview with the Secretary of the Indian Machine Tool Manufacturers' Association, 23rd April, 1968.

utilization during the last two and half years have been mainly caused by a lack of sufficient orders.¹ At the time, however, when these studies were made, the firms had more orders than they could handle.

The shortage of raw materials and components with reference to a particular machine tool plant can mean a different thing than what is understood in its overall sense. The production is held up because of the shortage of certain materials at a particular point of time, because the material was not issued out from the stores, or that particular components were not fabricated in sufficient quantities. If the position is such, the under-utilization of capacity is more due to the defective production planning than the real shortage of such components.

Some manufacturers agreed that a small reduction in the total cost of production may take place as a result of increased utilization of capacity, but according to their viewpoint, it is not worth the effort, especially in a sellers' market, when the products can be sold at a sufficiently higher price to offset any increase in cost of production due to under-utilization of capacity.²

1 Indian Machine Tool Manufacturers' Association, Bombay 1, 21st Annual Report, p. 10.

2 A few calculations would show the fallacies of this argument, and it is not really worthwhile to refute it.

The case for the manufacturers' point of view can be stated as follows:

(continued)

Much of the excess capacity caused by capital imbalance is mainly due to a lack of policy regarding the purchase of

(Footnote from last page continued)

Two firms are considered working with the same type of equipment. The Firm A has an index of utilization 25 and the Firm B, an index of utilization 50. Workers employed in both the firms are assumed to have equal productivity. Depreciation, supposed to be entirely due to wear and tear is reckoned at 10 per cent and 20 per cent for the Firm A and Firm B respectively, it being argued that with double the working hours, the machines must wear out twice as fast. On these assumptions, the calculations are as follows :-

First example of the costing of capacity utilization.

	<u>Firm A</u>	<u>Firm B</u>
	Rs.	Rs.
Annual gross output	1,000	1,000
Prime costs and gross profits:		
Raw materials	200	200
Labour	400	400
Gross Profits	400	400
Capital employed	2,000	1,000
Index of utilization	25	50
Fixed capital costs :		
Depreciation	200	200
Interest	100	50
Total capital charges (Depreciation + Interest)	300	250
Cost per Rupee of output:		
Materials	0.2	0.2
Labour	0.4	0.4
Capital	<u>0.3</u>	<u>0.25</u>
Total	0.9	0.85

In these calculations, no allowance is made for more number of workers to be used for increased utilization, or for increased incentive payments. Even on these unrealistic assumptions, the reduction in unit costs in the case of the Firm B is only about 5½ per cent of the total unit costs of the Firm A. As it is very small, considering the double the utilization of the Firm B, the argument runs that planning for greater utilization is not worthwhile from the point of view of cost considerations alone.

(continued)

capital equipment. Some of the machinery is purchased even though there may not be a crucial need for it. It happened that

(Footnote from last page continued)

Following fallacies in the above argument may be noted. First, so long as technical change is occurring, obsolescence cannot be validly ignored. To the annual charge of wear and tear, must be added the loss due to obsolescence. Secondly, it is rarely that the wear and tear varies proportionately with the actual operating time. Many machines deteriorate physically as much or more while they are idle as while they are in use, particularly if idle periods are short and frequent. Finally, the attention only to the amount of reduction in costs is not sufficient in itself. A small reduction in costs may not contribute to a starting improvement in the firm's competitive market power; but, suppose that the firm continues to sell at the same prices and concentrates attention on the rate of earnings on capital employed. Thus, let us examine the behaviour of the rate of earnings, that is, the difference between the unit costs (excluding interest charges), and the value of output, expressed as a percentage of the value of capital employed. In the Firm A, this is found to be 10 per cent and in the Firm B, 20 per cent. To double the rate of earnings is to achieve an economic change of major importance; and when the account is taken of the first two points (regarding obsolescence, and wear and tear), the difference becomes very marked.

In the second table given below, it was assumed that with 25 per cent utilization wear and tear depreciation runs at 10 per cent per annum; but when the utilization is doubled, this charge is increased by only a half. In addition it is assumed that obsolescence takes a further 5 per cent per annum of the value of capital employed, the same amount in both cases. The effect of doubling the rate of utilization is then to increase the rate of profit four-fold.

Second example of the costing of capacity:

	<u>Firm A</u>	<u>Firm B</u>
Index of utilization	25	50
Prime costs per Rupee of output	Rs. 0.6	Rs. 0.6
Gross profits per Rupee of output	0.4	0.4
Capital employed per Rupee of output	2.0	1.0
Depreciation per Rupee of output:		
Wear and tear	0.2	0.15
Obsolescence	<u>0.1</u>	<u>0.05</u>
Total	0.3	0.2
Earnings per rupee of output (Gross profit per Rs. of output minus Depreciation per Rs. of output)	0.1	0.2
Rate of gross profit on capital (%)	20	40
Rate of earnings on capital (%)	5	20

the managing director of one concern went abroad, saw some sophisticated modern types of machine tools at industrial exhibitions and ordered these without adequately taking into account the volume policy of the firm. The machines thus purchased may be suited to mass production method, requiring a sufficiently large volume of products and the firm actually manufactures only a few items. In effect, the machines lie idle.

The uncertainties of import policy also have prompted the management to buy the machinery whenever it was possible; with a fear that the import of such machines may be prohibited later on.

Finally, more often than not, it is a faulty planning regarding the selection of properly balanced plant equipment, which is responsible for the capital imbalance. The management must first take into account the types of quantities of products to be manufactured, the expected availability of raw materials and tools, and then should take decisions of selection of necessary equipment. It is true that sometimes the indivisibilities and economies of scale are such as to make it more economical to immediately instal a larger capacity and to operate at less than full capacity certain machines for some period rather than do without or employ a decidedly inferior technology. But even such a case implies a failure to arrange for marketing of the more quantity of the product that could be produced at a very little marginal cost.

Concluding Observations

The purpose of the Linear Programming Technique was to give a concept of optimum capacity and to establish the fact of capital balance in a machine tool firm. With more detailed data regarding every machine and every job, the model can serve to point out the extent of capital imbalance more exactly.

The machine tool industry is a capital intensive industry requiring heavy plant and machinery, some of which is to be imported. An important limiting factor in Indian industrial development is the lack of capital and foreign exchange. There is reason to believe that the machine tool factories in India can increase their output to a substantial extent with little or no increases in fixed plant, by increasing the capacity of bottleneck machines. By a suitable study of the existing processes, the weak links can be identified and the remedial action can be taken up. Hence, it would perhaps be advantageous to have people on the staff whose only function is to study the process with a view to increasing the capability of the system.

Such a study of capital imbalance can suggest guidelines for the policy of licensing of capacities. In actual fact, the licensing of firms, some of which are uneconomical producers, and have excess capacity, is a way of perpetuating high prices with no one gaining; not to mention the high cost of foreign exchange of this indiscriminate licensing. This

freezes a high price structure into the industry, since with only partial utilization, no one can truly afford to reduce the prices.

The detailed discussion of the licensing policy is given in the Chapter 10. Here we are concerned only with those aspects of the policy which can remove the state of capital imbalance and improve capacity utilization. Before licensing any new plants, or approving the expansion of existing ones, the licensing authority should be satisfied that it is not possible for the existing plants to fill the projected demand more economically. It should see whether marginal adjustments in the plant and machinery of the existing firms would result in increased production. The solicitation of such statements from existing producers and their sympathetic but critical review would give a tremendous impetus to a more desirable orientation by the management. The management on the other hand must learn to present its case on a factual and forthright basis. In preparing its case, it would do well to make use of outside management consultancy facilities, leaning on such facilities, particularly for fact finding.

The utilization of capacity can also be increased by better operations at the plant level. Grouping of components more or less according to the technology of their manufacture is conducive to forming technological groups so that a facility can be set up for a number of components at a time

leading to a reduction in the time of such occupations as setting up, tool change, work-piece loading and unloading, measuring, gauging, idle movements, etc.

Equally important is the effort of product designers in achieving plant utilization. Careful product analyses can result in wide application of standardized and oft repeated design groups leading to less diversification. An example is the new range of main drives and feed drives developed at HMT, which find application in a wide variety of machine tools. In this case, about 40 per cent of components become common among such different products as lathes, milling machines, boring machines, etc.

The improvement in the working of the production planning department and work study methods can usefully result in better plant utilization. The application of computers in this respect becomes important. But only a large firm with the size and resources of HMT can afford to own a computer. The four or five firms can pool their resources together and purchase a computer for their common use, thus availing themselves of the facilities of modern data processing methods.

In addition the approaches to increased utilization can be such as suggested: (1) multi-shift operation; (2) reduction of machine waiting; (3) staggered lunch periods and the use of relief men; (4) speed-up the pace of labour through use of incentives with provision of rest periods; (5) preventing idle time due to absenteeism.

In 1964-65, when the case studies of two firms were made, the manufacturers did not face the problem of the lack of demand. Since then, however, lack of demand for machine tools has been the main reason for the unutilized capacity. This aspect is considered in the next chapter, following the discussion of the pattern of the past demand for machine tools.

CHAPTER 9DEMAND AND SUPPLY OF MACHINE TOOLS

The discussion of factors such as raw materials, prices and marketing, finances, capacity utilization, labour force and entrepreneurship indicated the structure of the machine tool industry as it is today, and as it has developed in the past. In the ensuing pages, the question of expected demand for and supply of machine tools will be discussed, in the light of the recent recession, following the analysis of the pattern of past demand. Such an analysis of past demand is deemed to be useful only so far as it might provide clues to the direction of and shift in future demand.

I

The Analysis of Past Demand

The growth of Indian demand for machine tools is roughly indicated by the consumption figures for graded machine tools, which are graphed in Figure 9.1.¹ The Indian demand for

¹ The annual consumption figures for machine tools are derived by adding together annual imports and production figures. Yearly exports are not subtracted from these figures as they also represent part of demand for Indian machines. Moreover, the exports form a negligible proportion of the Indian consumption of machine tools.

Imports figures prior to 1956 are extracted from Annual Statement of Sea-Borne Trade of India, op.cit., and those after 1956 from The Monthly Statistics of the Foreign Trade of India, op.cit., for the years in question.

The figures are not strictly comparable over time, since they include the consumption for Burma prior to 1937 and for Pakistan prior to 1947.

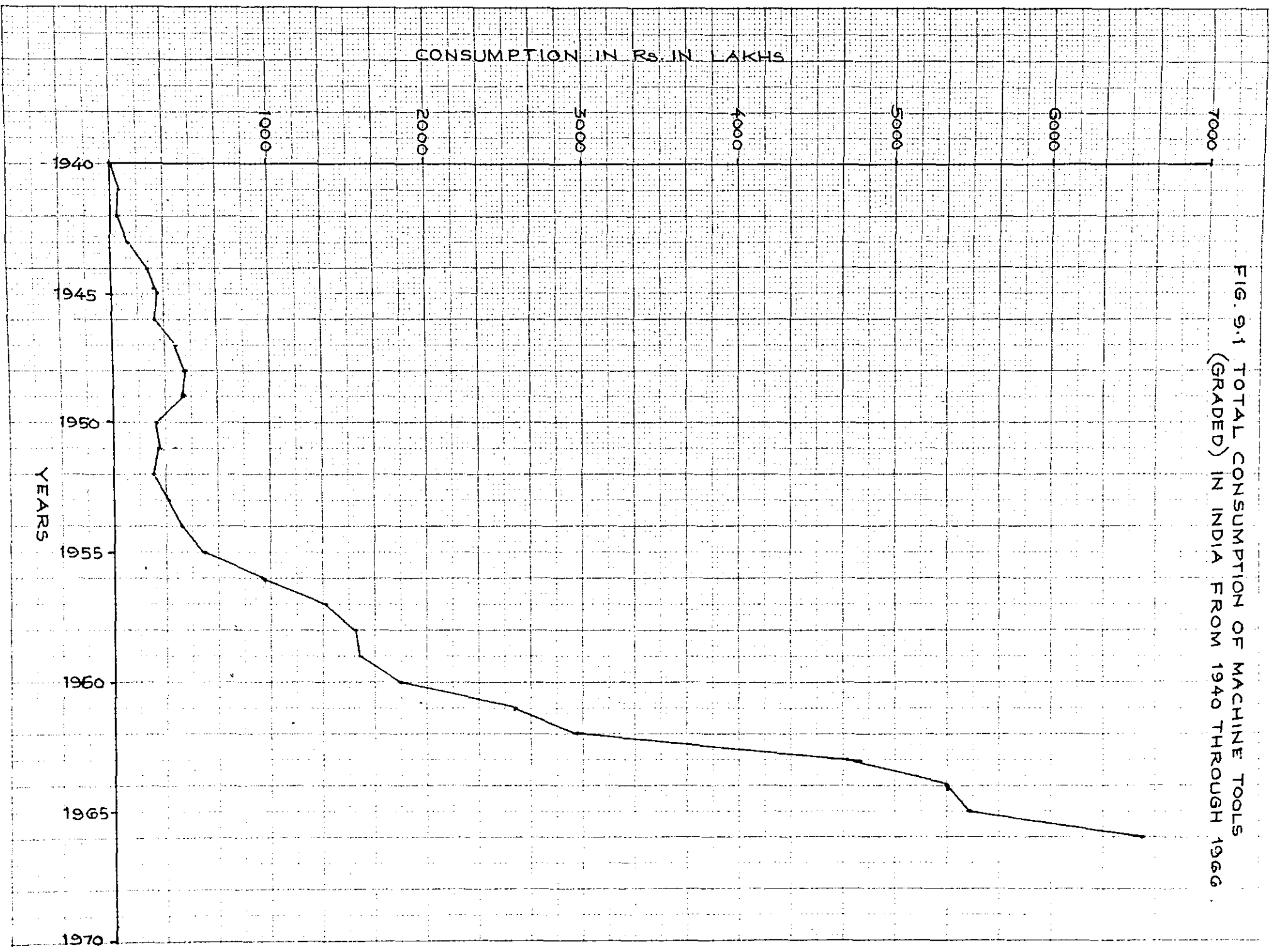


FIG. 9.1 TOTAL CONSUMPTION OF MACHINE TOOLS (GRADED) IN INDIA FROM 1940 THROUGH 1966.

machine tools prior to 1941 was almost entirely met by imports, as there was hardly any indigenous machine tools produced in the country before the beginning of the Second World War. The imports of graded machine tools amounted to Rs. 84 lakhs in 1921-22. After 1922-23, the quantity of imports went on decreasing, while in 1931-32 only Rs. 19 lakhs of machine tools were imported. Throughout the depression years from 1931-32 through 1935-36, the annual imports remained less than Rs. 20 lakhs.

With the outbreak of the Second World War, the Indian demand for machine tools shot up and has been increasing steadily over years with the exception of the period just after the Korean War in early 1950s. The total demand has increased to Rs.6595 lakhs in 1966, that is, about 97 times the demand in 1941.¹

Countrywise Imports of Machine Tools

A large part of the Indian demand, for machine tools, despite a substantial increase in indigenous production, has been met by imports. Except during 1943, when there was difficulty of securing imports from the United Kingdom and other belligerent countries, which were the main exporters of machine tools to India, the proportion of imports in the total annual Indian demand for machine tools has been more than about 60 per cent.²

1 Table 1.1, Chapter 1.

2 Ibid.

The Table 9.1 indicates the countrywise classification of imports of machine tools in India. Upto 1951-52, the United Kingdom accounted for a major portion of imports. In 1941-42, the imports from the United Kingdom were reduced due to the exigencies of the Second World War, but its share in India's imports was greater than that of any other country. Upto 1951-52, a part of India's import needs were supplied by U.S.A. and Germany. During the Second World War, however, there were no imports of machine tools from Germany.

In recent years, the share of the United Kingdom in India's imports of machine tools is seen to have diminished. Still in 1961-62, its share (24 per cent) was greater than that of any other country. Next in order of importance are West Germany (with 18 per cent of India's machine tools imports) and U.S.A. (16 per cent).

Though these three countries continued to account for a major share in India's machine tools imports in 1961-62, a fact may be noted that the U.S.S.R. and other Eastern European countries accounted for a sizeable part (28 per cent) of India's machine tools imports in that year, while before 1951-52, India did not import any significant quantity of machine tools from these countries. The imports from these latter countries are probably due to the Rupee Payment Agreements between these countries and India, and also due to other aspects of economic co-operation. Indian firms have, during the last decade, entered into collaboration agreements

Table 9.1 : Countrywise Analysis of Imports of Machine Tools (Value in Rs. Thousands)

Country	1921-22		1931-32		1941-42		1951-52		1961-62	
	Value	Percentage	Value	Percentage	Value	Percentage	Value	Percentage	Value	Percentage
U.S.A.	2,426	29	175	9	2,273	40	1,332	7	31,253	16
U.S.S.R.	-	-	-	-	-	-	-	-	10,417	5
Germany East	-	-	-	-	-	-	-	-	6,345	3
Czechoslovakia	-	-	-	-	-	-	975	5	15,953	8
Poland	-	-	-	-	-	-	-	-	4,952	3
Hungary	-	-	-	-	-	-	39	-	2,455	1
Yugoslavia	-	-	-	-	-	-	-	-	15,626	8
United Kingdom	5,508	65	1,385	72	2,608	45	12,404	69	44,693	24
Germany West	49 ^{a/}	1	278 ^{a/}	15	-	-	1,680	10	34,276	18
Other European Countries	414	5	40	2	-	-	1,165	7	20,655	11
Japan	9	0	-	-	147	2	111	1	2,267	1
Others	4	0	46	2	670	13	242	1	1,048	1
Total	8,410	100	1,924	100	5,698	100	17,948	100	190,500	100

^{a/} - Includes East Germany also.
 Zero indicates that the figure is less than 0.5.
 Year ending on 31st of March.

Source : i) Government of India, Department of Commercial Intelligence and Statistics. Monthly Statistics of the Foreign Trade of India Vol.II - Imports, March 1961-62.
 ii) Annual Statement of Sea-Borne Trade of India

with manufacturers in other countries in addition to U. K. and U.S.A. They import machinery from these countries as part of the collaboration agreements. The import of different types and designs of machine tools has created the need for special know-how, in order to keep these machines in maintenance. The designers in Indian firms have opportunity to study design features of machines from various countries and to imitate these if possible.

Typewise Analysis of Past Demand of Machine Tools in India

Any significant changes over years in the past demand of machine tools in India, by types, cannot be shown, as the accurate data regarding indigenous production by types was not available over a longer period. However, it is attempted to show what the situation in recent years was, from the data regarding imports, indigenous production and exports by major types, which was available.

The past demand by types of machine tools from 1963 through 1966 is indicated in Table 9.2 giving the typewise analysis of consumption during these years.

During the four years from 1963 through 1966, the demand for lathes (by value) was larger (21 per cent) than the demand for any other type. Next in order of importance are milling and grinding machines (13 per cent of the total consumption

Table 9.2 : Pattern of Past Demand for Graded Machine Tools in India (Value Rs. in Lakhs)

Type	1963			1964			1965			1966			Total of four years 1963 to 1966		Past demand 1955-1959			
	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)	Nos.		
Automatics	65	33.99	(1)	211	124.31	(2)	217	66.25	(1)	219	163.81	(2)	712	(-)	388.56	(2)	245	(-)
Boring	420	326.02	(7)	2453	477.36	(9)	478	406.21	(7)	359	441.88	(7)	3020	(3)	1651.77	(7)	1659	(3)
Broaching	36	29.85	(1)	30	35.79	(1)	33	28.21	(1)	19	46.57	(1)	118	(-)	140.42	(1)	24	(-)
Drilling	2185	364.34	(8)	3431	323.77	(6)	3606	329.30	(6)	2543	356.17	(5)	11765	(13)	1373.58	(6)	8394	(14)
Gear-cutting	150	83.14	(2)	253	98.57	(2)	147	45.01	(1)	193	83.70	(1)	793	(1)	310.42	(1)	210	(-)
Grinding	3925	563.47	(12)	3316	646.94	(12)	4722	727.92	(13)	3685	835.76	(13)	15648	(17)	2774.09	(13)	11746	(20)
Lapping, Honing, Polishing	163	28.56	(1)	299	43.84	(1)	226	40.00	(1)	561	51.97	(1)	1249	(1)	164.37	(1)	3269	(6)
Capstans and Turrets	585	231.36	(5)	517	223.94	(4)	655	275.30	(5)	664	348.90	(5)	2421	(2)	1079.50	(5)	1592	(3)
Lathes	6632	1093.11	(23)	6700	1124.46	(21)	6446	993.58	(18)	6438	1327.76	(20)	26476	(28)	4539.11	(21)	9564	(16)
Milling	1284	279.07	(6)	1638	721.92	(14)	2068	980.72	(18)	1623	947.08	(14)	6613	(7)	2928.79	(13)	2987	(5)
Planing	182	92.67	(2)	193	108.45	(2)	209	154.76	(3)	229	186.28	(3)	813	(1)	542.16	(2)	289	(-)
Presses	1535	464.72	(10)	1190	605.09	(11)	1908	567.78	(10)	1430	550.56	(8)	6063	(6)	2438.46	(11)	3003	(5)
Sawing	617	43.18	(1)	610	47.28	(1)	909	71.45	(1)	623	71.47	(1)	2759	(3)	260.97	(1)	1211	(2)
Shaping	528	73.99	(2)	762	61.06	(1)	791	90.10	(2)	807	96.73	(1)	2888	(3)	321.88	(1)	1401	(2)
Shearing, Plate and Sheet Metal	611	131.06	(3)	425	96.00	(2)	505	105.00	(2)	444	119.26	(2)	1985	(2)	451.32	(2)	8619	(15)
Slotting	139	15.01	(-)	101	19.48	(-)	168	21.65	(-)	112	35.09	(-)	520	(1)	91.23	(-)	279	(-)
Screwing	31	16.77	(-)	103	17.55	(-)	98	10.65	(-)	40	16.12	(-)	272	(-)	61.09	(-)	462	(1)
Threading	134	16.76	(-)	60	15.13	(-)	220	46.60	(1)	152	87.06	(1)	563	(1)	165.44	(1)	184	(-)
Tapping	41	7.45	(-)	71	11.20	(-)	98	22.71	(-)	41	4.19	(-)	251	(-)	45.65	(-)	349	(1)
Bending, other than rolls	187	18.11	(-)	179	19.82	(-)	423	60.71	(1)	163	106.67	(2)	952	(1)	205.31	(1)	1488	(3)
Hammers	117	88.10	(2)	85	80.84	(2)	114	108.20	(2)	204	117.58	(2)	520	(1)	394.72	(2)	1113	(2)
Reeling	-	-	-	14	1.33	(-)	-	-	(-)	-	-	(-)	14	(-)	1.33	(-)	34	(-)
Machine Tools for working metals (NES)	1899	344.68	(7)	875	453.10	(8)	4319	333.05	(6)	1638	600.29	(9)	8731	(9)	1711.12	(8)	-	(-)
Total	21457	4694.41	(100)	21922	5336.01	(100)	28360	5484.20	(100)	22158	6595.20	(100)	93907	(100)	22109.82	(100)	58110	(100)

NES - Not Elsewhere Specified. Figures in brackets show percentages to the total. The dash indicates the figure is less than 0.5.

Sources : Tables 9.4 and 9.5. The figures of imports and production for respective years are added to give consumption figures.

Government of India, Ministry of Commerce and Industry, Development Wing. An Assessment of Machine Tool Demand during the Third Plan Period.
New Delhi, p. 13, for Past demand 1955-1959.

during these four years), drilling and boring machines (13 per cent), presses (11 per cent) and capstans and turrets (5 per cent). The shares of automatics, gear-cutters and gear-shapers are much smaller when compared to those of major types such as lathes, milling, drilling and boring machines. The shares of other metal forming machines than presses are negligible.

The shares of major types in the Indian consumption of machine tools from 1963 through 1966 may be compared to those in U.K., U.S.A. and West Germany in their consumption of machine tools during 1960, given in Table 9.3. The percentage share of lathes (including capstans and turrets) in Indian consumption is in line with that in U.K. and West Germany, while the share of lathes in U.S.A. is smaller. The share of boring and drilling machines in Indian consumption is larger than that in the consumption of these countries. The percentage share of milling machines compares favourable with that in these countries. The share of presses is much smaller in Indian consumption than that in West Germany's consumption. The Indian consumption of gear-cutting machines is much smaller than that of these countries. While the percentage share of grinding machines is in line with other countries, the greater part (60 per cent) of grinding machines used in India is made up of simple single and double ended grinders.¹

¹ Demand for Machine Tools, op.cit., p. 33.

If the pattern of industrialized countries is to be followed, there should be a greater use of gear-cutting machines, grinding machines of advanced types and lesser dependence on lathes and drilling machines.

Table 9.3 : Pattern of Demand for Machine Tools in U.K., U.S.A., West Germany and India (Percentage figures by Value)

Machine Type	U. K.	U.S.A.	West Germany	India
	1960 (Per cent)	1960 (Per cent)	1960 (Per cent)	1963-1966 (Per cent)
Boring	11.9	6.4	6.2	7.0
Drilling		5.8		6.0
Gear-cutting	3.0	2.7	4.1	1.0
Grinding	13.1	15.2	11.5	13.0
Lathes	23.1	19.5	27.0	26.0
Milling	10.3	11.8	8.3	13.0
Planing, Shaping, Slotting	2.7	--(a)	3.5	3.0
Presses	14.2	13.9	20.2	11.0
All Others	21.7	24.7	19.2	20.0
Total	100.0	100.0	100.0	100.0

Source : 'Metal-working Production' 1962, quoted from NCALR's Demand for Machine Tools, p. 70, for data regarding U.K., U.S.A. and West Germany.

Figures for India derived from Table 9.2.

The past demand by types during 1955-59 (by numbers) is compared to the demand by types during 1963-66 (by numbers) in Table 9.2. The percentage share of lathes in consumption has increased from 1954-59 to 1963-66, though recently, lathes of more advanced designs are being used. The share of boring and drilling machines is almost the same in two periods. The percentage shares of milling machines and presses during 1963-66 consumption are greater than that during 1955-59. A curious fact is that the share of grinding machines has decreased during 1963-66 as compared to that during 1955-59. With the progress of industrialization, more dependence on grinding machines expected. Probably, the dependence on simple types of grinders has comparatively decreased, while more internal and cylindrical and other advanced types of grinders are in use, with the result that though the value of grinders consumed during 1963-66 might have gone up as compared to that in 1955-59, the number of grinders used has decreased. On the other hand, percentage shares of gear-cutting machines, automatic planers were insignificant during 1955-59 consumption of machine tools in India.

The typewise analysis of indigenous production in Table 9.4 indicates that during 1963-66, the percentage share of lathes in the indigenous production was the largest (34.8 per cent). Next in order of importance are milling machines (19.7 per cent), boring and drilling machine (12.7 per cent) and grinding machines (9.7 per cent). The shares of gear-

Table 9.4 : Typewise Analysis of Indigenous Production of Graded Machine Tools (Value in Rs. Lakhs)

Type	1963			1964			1965			1966			Total 1963 to 1966		
	Nos.	Value	Per cent	Nos.	Value	Per cent	Nos.	Value	Per cent	Nos.	Value	Per cent	Nos.	Value	Per cent
Automatics	-	-	-	65	17.73	9.3	182	41.55	1.9	165	37.14	(1.5)	412	96.62	1.2
Boring	16	26.40	(2.1)	31	42.32	2.2	22	36.28	1.6	52	76.51	(3.1)	121	181.52	2.3
Broaching	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drilling	1493	180.80	(14.5)	2921	197.02	10.4	3107	205.24	9.2	2249	233.70	(9.4)	9770	816.76	10.4
Gear-Cutting	-	-	-	-	-	-	3	1.19	0.1	18	8.28	(0.3)	21	9.47	0.1
Grinding	1254	96.80	(7.8)	1469	155.90	8.2	2025	237.39	10.7	1859	221.51	(8.9)	6607	711.60	9.1
Lapping, Honing Polishing	53	0.50	-	119	3.35	0.2	45	1.53	0.1	356	17.55	(0.7)	573	22.93	0.3
Capstans and Turrets	97	50.90	(4.1)	160	69.66	3.7	274	132.71	6.0	392	191.86	(7.7)	923	445.13	5.7
Lathes	5364	633.30	(50.9)	5779	676.16	35.7	5585	603.36	27.1	5892	821.74	(32.9)	22620	2734.56	34.8
Milling	703	33.10	(2.7)	979	425.37	22.5	1382	610.33	27.4	1091	480.22	(19.3)	4155	1549.02	19.7
Planing	128	34.30	(2.8)	127	43.86	2.3	156	60.25	2.7	179	62.90	(2.5)	590	201.31	2.6
Presses	638	59.70	(4.8)	734	80.09	4.2	986	85.46	3.8	877	95.77	(3.8)	3235	522.33	6.7
Sawing	474	18.90	(1.5)	467	25.72	1.4	548	32.51	1.5	406	29.46	(1.2)	1895	106.59	1.4
Shaping	500	58.50	(4.7)	735	56.69	3.0	719	72.28	3.2	734	81.35	(3.2)	2688	268.82	3.4
Shearing, Plate and Sheet Metal	241	21.30	(1.7)	241	28.25	1.5	194	24.86	1.1	294	36.84	(1.5)	970	121.25	1.4
Slotting	81	9.60	(0.8)	68	10.84	0.6	85	12.36	0.6	83	20.72	(0.8)	317	53.52	0.7
Screwing	-	-	-	3	0.29	0.0	29	3.07	0.1	22	2.76	(0.1)	54	6.12	0.1
Threading	-	-	-	3	0.11	0.0	-	-	-	-	-	-	-	-	-
Tapping	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bending other than rolls	-	-	-	5	0.84	0.0	8	1.66	0.1	12	1.05	(0.1)	25	3.55	-
Hammers	25	19.70	(1.5)	42	42.05	2.2	49	36.63	1.6	56	37.21	(1.5)	172	135.59	1.7
Reeling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Machine tools for working metals (NES)	-	-	-	16	15.33	0.8	24	26.98	1.2	32	34.70	(1.39)	72	77.01	1.0
Total	11058	1543.80	(100)	13370	1891.60	(100)	15423	2225.64	(100)	14769	2491.27	(100)	54620	8152.31	(100)

NES - Not Elsewhere Specified.

Figures in brackets show percentages to the total (for value figures only).

Source : Indian Machine Tool Manufacturers' Association, Bombay 1.

cutters, milling machines, presses are small considering their percentage shares in total past demand. More than half of the Indian demand for gear cutters, presses, boring machines, automatics, broaching, grinding machines, shearing, sheet and plate metal working machinery, threading, tapping, bending machines, etc. is met by imports. In the typewise analysis of imports, the share of grinding machines is the largest (15 per cent), next in order of importance are presses, lathes, boring and milling machines (Table 9.5).

The exports of machine tools from India during 1963-66 are less than one per cent of the indigenous production during the same period. Lathes, and milling machines account for a large portion of exports (Table 9.6).

Changes in the pattern of demand over years may also be detected from the inventory data presented in Table 9.7, for the years 1954, 1959 and 1963. Lathes, drilling machines and grinding machines have larger percentage shares in the machine tools installed than any other types. In 1959 and 1963, the percentage shares of drilling machines are less than those of grinding machines. The share of gear-cutting machines has increased over years. There is greater use of automatics in 1959 and 1963 as compared to that in 1954. The percentage share of milling machines is seen to be increasing. Though the absolute amount of presses installed has increased in 1963, its percentage share in the total inventory has decreased.

Table 9.5 : Typewise Analysis of Imports of Graded Machine Tools (Value in Rs. Lakhs)

Type	1963			1964			1965			1966			Total (four years) 1963 to 1966		
	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)	Nos.	Value	(%)
Automatics	65	33.99	(1)	146	106.58	(3)	35	24.70	(1)	54	126.67	(3)	300	291.94	(2)
Boring	414	299.62	(10)	1422	435.04	(13)	456	369.93	(11)	307	365.37	(9)	2899	1470.26	(11)
Broaching	36	29.85	(1)	30	35.79	(1)	33	28.21	(1)	19	46.57	(1)	118	140.42	(1)
Drilling	692	183.54	(6)	510	126.75	(4)	499	124.06	(4)	294	122.47	(3)	1995	556.82	(4)
Gear-cutting	150	83.14	(3)	253	98.57	(3)	144	43.82	(1)	175	75.42	(2)	772	300.95	(2)
Grinding	2671	466.67	(15)	1847	491.04	(14)	2697	490.53	(15)	1826	614.25	(15)	9041	2062.49	(15)
Lapping, Honing, Polishing	110	28.06	(1)	180	40.49	(1)	181	38.47	(1)	205	34.42	(1)	676	141.44	(1)
Capstans and Turrets	488	180.46	(6)	357	154.28	(4)	381	142.59	(4)	272	157.04	(4)	1498	634.37	(4)
Lathes	1258	459.81	(15)	921	448.30	(13)	861	390.22	(12)	546	506.22	(12)	3856	1804.55	(13)
Milling	581	245.97	(8)	659	296.55	(9)	686	370.39	(11)	532	466.86	(11)	2458	1379.77	(10)
Planing	54	58.37	(2)	66	64.59	(2)	53	94.51	(3)	50	123.38	(3)	223	340.85	(2)
Presses	897	454.02	(14)	456	525.00	(15)	922	482.32	(15)	553	454.79	(11)	2828	1916.13	(14)
Sawing	143	24.28	(1)	143	21.56	(1)	361	38.94	(1)	217	42.01	(1)	864	126.79	(1)
Shaping	28	15.49	(-)	27	4.37	(-)	72	17.82	(1)	73	15.38	(-)	200	53.06	(-)
Shearing, Plate and Sheet Metal	370	109.76	(3)	184	67.75	(2)	311	80.14	(2)	150	82.42	(2)	1015	340.07	(2)
Slotting	58	5.41	(-)	33	8.64	(-)	83	9.29	(-)	29	14.37	(-)	203	37.71	(-)
Screwing	31	16.77	(-)	100	17.26	(1)	69	7.58	(-)	18	13.36	(-)	218	54.97	(-)
Threading	134	16.76	(-)	57	15.02	(-)	220	46.60	(1)	152	87.06	(2)	563	165.44	(1)
Tapping	41	7.45	(-)	71	11.20	(-)	98	22.71	(1)	41	4.19	(-)	251	45.55	(-)
Bending, other than rolls	187	18.11	(1)	174	18.98	(1)	415	59.05	(2)	151	105.62	(3)	927	201.76	(1)
Hammers	92	68.40	(2)	43	38.79	(1)	65	71.57	(2)	148	80.37	(2)	348	259.13	(2)
Reeling	-	-		14	1.33	(-)	-	-		-	-		14	1.33	(-)
Machine tools for working metals (NES)	1899	344.68	(11)	859	417.77	(12)	4295	306.07	(9)	1606	565.59	(14)	8659	1634.11	(12)
Total	10399	3150.61	(100)	8532	3444.41	(100)	12937	3258.56	(100)	7389	4103.93	(100)	39287	13957.51	(100)

NES - Not Elsewhere Specified. Figures in brackets show percentages to the total (for value figures only).

Source : Government of India, Department of Commercial Intelligence and Statistics. Monthly Statistics of the Foreign Trade of India, Vol. II - Imports. Volumes from 1963 through 1966.

Table 9.6 : Typewise Analysis of Exports of Machine Tools (Year ended March)

Type	1963-64			1964-65			1965-66			1966-67 (From June 1966 to March 1967)		
	No.	Value	Percentage	No.	Value	Percentage	No.	Value	Percentage	No.	Value	Percentage
Boring	-	-	-	-	-	-	4	24,850	1.2	-	-	-
Drilling	2	5,310	0.8	3	27,900	3.9	41	413,866	19.6	44	791,352	24.6
Lapping and Honing	-	-	-	-	-	-	7	14,797 ^{a/}	0.7	28	42,648	1.3
Grinding	43	13,573	2.2	65	37,642	5.2	45	34,135	1.6	49	135,500	4.2
Gear-cutting	2	2,267	0.3	-	-	-	-	-	-	-	-	-
Capstans and Turrets	-	-	-	-	-	-	2	85,177	4.0	-	-	-
Lathes	37	172,071	28.6	111	459,317	63.4	97	403,325	19.1	143	645,531	20.1
Milling	46	102,817	17.1	-	-	-	24	531,121	25.2	49	1,056,827	32.9
Planing	-	-	-	-	-	-	2	5,252	0.2	1	18,899	0.6
Presses	106	140,036	23.3	72	70,287	9.7	57	144,976	6.9	85	71,865	2.2
Sawing	6	17,799	3.0	9	11,278	1.6	146	98,924	4.7	4	8,587	0.3
Screwing	4	12,698	2.1	-	-	-	-	-	-	-	-	-
Shaping	5	29,355	4.9	21	58,486	8.1	11	74,537	3.5	20	167,685	5.2
Slotting	1	18,934	3.2	1	20,000	2.8	-	-	-	3	58,000	1.8
Shearing, Plate and Sheet Metal	14	41,579	6.9	1	2,590	0.4	15	602 ^{b/}	0	46	39,773 ^{b/}	1.2
Polishing	-	-	-	-	-	-	-	-	-	-	-	-
Tapping	-	-	-	-	-	-	1	625	0	-	-	-
Treading	1	4,644	0.8	-	-	-	-	-	-	-	-	-
Bending other than rolls	-	-	-	3	2,275	0.3	-	-	-	1	1,680	0.1
Machine tools working metals (NES)	34	40,002	6.6	320	34,523	4.8	806	273,127	13.0	34	175,630	5.5
Total Machine Tools		601,085	100.0		724,298	100.0		2,105,314	100.0		3,213,977	100.0

a/ includes polishing machines; b/ includes punching machines.

Zero indicates that the figure is less than 0.5.

Source : Government of India, Department of Commercial Intelligence and Statistics, Calcutta. Monthly Statistics of the Foreign Trade of India, Vol. I - Exports and Re-exports. Volumes from March 1964 through March 1967.

Table 9.7 : Changes in the Pattern of Demand (Inventory of Graded Machine Tools) - Figures in Numbers

Type of Machine Tool	Installed 1954 Nos.	Per cent	Installed 1959 Nos.	Per cent	Installed 1963 Nos.	Per cent	Inventory of machine tools in U.S.A. 1963 Nos.	Per cent
Automatic	518	0.8	763	0.6	2,726 ^{a/}	1.3	107,848 ^{c/}	3.4
Boring	1,089	1.7	2,748	2.3	4,195	1.9	80,148	2.5
Broaching	44	-	68	0.1	173	0.1	14,806	0.5
Drilling	10,118	16.2	18,512	15.4	21,524	10.0	446,618	13.9
Gear Cutting	244	0.4	454	0.4	1,703	0.8	51,665	1.6
Grinding	8,208	13.1	19,954	16.6	35,129	16.3	436,021	13.6
Lapping and Honing	118	0.2	598	0.5	826	0.4	27,492	0.9
Capstans and Turrets	2,463	3.9	4,055	3.4	7,693	3.6	90,907	2.8
Lathes	12,375	19.8	21,942	18.2	50,004	23.1	248,424	7.7
Milling	2,597	4.1	5,584	4.6	11,774	5.4	236,346	7.4
Planing	848	1.4	1,128	0.9	1,603	0.7	14,101	0.4
Presses	9,964	15.9	12,967	10.8	15,200	7.0	351,296	10.6
Sawing	1,715	2.7	2,926	2.4	6,541	3.0	148,816	4.6
Shaping	1,929	3.0	3,360	2.8	3,875	1.8	36,907 ^{d/}	1.2
Shearing, Plate and Sheet Metal	5,600	9.00	14,219	11.8	9,405	4.4	48,374	1.5
Slotting	726	1.2	1,005	0.8	2,161	1.0	-	-
Screwing	1,063	1.7	1,525	1.2	N.A.	-	-	-
Threading	209	0.3	393	0.3	1,487	0.7	26,172	0.8
Polishing and Buffing	1,519	2.4	4,308	3.6	4,699 ^{e/}	2.2	97,487	3.0
Tapping	260	0.4	609	0.5	1,278	0.6	29,964	0.9
Bending other than rolls	235	0.4	1,717	1.4	3,615	1.7	671,033 ^{e/}	20.9
Hammers	613	1.0	1,726	1.4	3,981	1.8	12,631	0.4
Reeling	9	-	43	0.1	N.A.	-	-	-
Machine Tools for Working Metals (NES)	-	-	-	-	26,528	12.3	28,826 ^{f/}	0.9
Total	62,464	100.0	120,574	100.0	216,120	100.0	3,205,855	100.0

a/ - Includes semi-automatic lathes

b/ - Includes buffing machines also

c/ - Includes automatic lathes and automatic screw machines

d/ - Includes slotters

e/ - Includes bending rolls

f/ - Includes special way-type machines (20,668) and electro-erosion machines (3,643).

Sources : (1) Government of India, Ministry of Commerce and Industry, Development Wing, An Assessment of Machine Tool Demand During the Third Plan Period, New Delhi, 1962, p. 13, for inventory data for 1954 and 1959.

(2) National Council of Applied Economic Research. Demand for Machine Tools. New Delhi, August 1965, pp. 60, 71-75, for inventory data for 1963 and U.S.A. Inventory data for 1963.

The inventory of machine tools in India in 1963 may be compared to that in U.S.A. in the same year, given in Table 9.7. American machine tool using industries, employ lesser percentage of lathes than the Indian industries. The percentage shares of drilling and grinding machines in U.S.A. are in line with the shares of these items in Indian inventory. In U.S.A. higher percentage shares of automatics, boring and gear-cutting machines, milling machines in the inventory may be noted. The use of special purpose machinery, electro-erosion machines in U.S.A. is indicative of adoption of advanced technology.

The Pattern of Industrywise Demand

The percentages of the types of machine tools to the demand of machine tools by various machine tool using industries may indicate the shift in the types of demand depending upon the growth rates of these industries. Inventory of machine tools in various industries is given in Table 9.8. The percentage share of lathes in the total inventory in most of the cases is larger than the share of any other. Heavy mechanical engineering industries (A) are using more drilling and boring machines than any other type. The pattern of typewise demand in industrial machinery industries (C) and machine tool industry (D) is mostly similar, though machine tool industry use more of grinders and less of lathes than the industrial machinery industry. Percentage shares of

Table 9.8 : Industrywise Inventory of Machine Tools Installed in 1963 (in Numbers)

Type	Metal Working Industries													
	A		B		C		D		E		F		G	
Boring	117	(1)	45	(1)	436	(5)	251	(4)	555	(4)	165	(2)	-	
Broaching	-		10	(-)	30	(-)	18	(-)	79	(1)	34	(-)	6	(-)
Drilling	1925	(20)	1586	(16)	1317	(15)	678	(10)	2353	(18)	1956	(21)	276	(16)
Gear-cutting, Shaping etc.	48	(1)	90	(1)	229	(3)	186	(3)	295	(2)	41	(-)	18	(1)
Grinding	1195	(13)	1451	(15)	1300	(15)	1516	(22)	2113	(16)	1114	(12)	786	(11)
Lapping and Honing	21	(-)	57	(1)	21	(-)	71	(1)	164	(1)	51	(1)	6	(-)
Lathes (including Capstans and Turrets)	1684	(18)	2553	(26)	2592	(30)	1744	(26)	3735	(29)	2113	(23)	720	(42)
Milling	258	(3)	582	(6)	732	(9)	751	(11)	1142	(9)	578	(6)	324	(19)
Planing	170	(2)	28	(-)	220	(3)	204	(3)	108	(1)	48	(1)	12	(1)
Sawing (including Cutoff, Contour Sawing and Filing)	704	(7)	211	(2)	365	(4)	269	(4)	405	(3)	411	(4)	30	(2)
Shaping	374	(4)	263	(3)	376	(4)	284	(4)	429	(3)	278	(3)	12	(1)
Shearing, Plate and Sheet Metal	294	(3)	190	(2)	148	(2)	77	(1)	187	(1)	208	(2)	12	(1)
Threading	325	(3)	133	(1)	44	(-)	64	(1)	44	(-)	69	(1)	6	(-)
Tapping	360	(4)	198	(2)	35	(-)	17	(-)	87	(1)	262	(3)	18	(1)
Presses (including Forging Presses)	784	(8)	3121	(32)	206	(2)	219	(3)	904	(7)	1625	(17)	78	(4)
Bending (other than rolls)	36	(-)	4	(-)	124	(1)	21	(-)	30	(-)	71	(1)	6	(10)
Polishing and Buffing	435	(5)	540	(6)	146	(2)	75	(1)	159	(1)	144	(2)	25	(1)
Other metal-cutting	719	(8)	82	(1)	87	(1)	316	(3)	89	(1)	125	(1)	-	
Total	9449	(100)	9641	(100)	8542	(100)	6761	(100)	12878	(100)	9293	(100)	1735	(100)

Figures in brackets show percentages to the total.

Group A - Heavy Mechanical Engineering.
 Group B - Light Mechanical Engineering.
 Group C - Industrial Machinery.
 Group D - Tools and Machine Tools.

Group E - Automobiles, Internal Combustion Engines and Allied Industries.
 Group F - Electrical Engineering.
 Group G - Instruments.

(continued)

Table 9.8 : (continued)

Type	Metal Working Industries						Total Metal-working Industries	Non-metal based Industries	Railways		Power and Irrigation			
	H		I		J									
Boring	67	(3)	49	(2)	2	(1)	1688	(3)	136	(1)	594	(4)	30	(1)
Broaching	-		-		-		177	(-)	-		10	(-)	-	
Drilling	400	(16)	266	(12)	14	(4)	10771	(16)	2957	(18)	2460	(18)	1059	(25)
Gear-cutting, Shaping etc.	29	(1)	-		-		936	(1)	130	(1)	57	(-)	10	(-)
Grinding	398	(16)	194	(9)	27	(8)	9494	(14)	2194	(13)	2092	(15)	1108	(26)
Lapping and Honing	8	(-)	10	(-)	-		409	(1)	4	(-)	37	(-)	-	
Lathes (including Capstans and Turrets)	786	(31)	580	(27)	168	(50)	16675	(25)	6637	(40)	4487	(32)	1424	(33)
Milling	137	(5)	274	(13)	9	(3)	4787	(7)	515	(3)	629	(5)	77	(2)
Planing	118	(5)	50	(2)	7	(2)	965	(1)	505	(3)	272	(2)	40	(1)
Sawing (including Cutoff, Contour Sawing and Filing)	308	(12)	213	(10)	13	(4)	2929	(4)	849	(5)	441	(3)	318	(7)
Shaping	181	(7)	177	(8)	11	(3)	2385	(4)	1472	(10)	1292	(9)	122	(3)
Shearing, Plate and Sheet Metal	13	(1)	28	(1)	5	(2)	1162	(2)	194	(1)	338	(2)	20	(-)
Threading	13	(1)	49	(2)	2	(1)	749	(1)	375	(2)	269	(2)	50	(1)
Tapping	3	(-)	40	(2)	-		1020	(2)	-		72	(1)	-	
Presses (including Forging Presses)	10	(-)	149	(7)	7	(2)	7103	(11)	264	(2)	467	(3)	27	(1)
Bending (other than rolls)	10	(-)	3	(-)	-		305	(-)	41	(-)	71	(1)	5	(-)
Polishing and Buffing	10	(-)	18	(1)	16	(5)	1568	(2)	47	(-)	110	(1)	-	
Other Metal-cutting	25	(1)	19	(1)	52	(16)	1514	(2)	108	(1)	169	(1)	10	(-)
Total	2516	(100)	2137	(100)	333	(100)	65799	(100)	16428	(100)	13867	(100)	4300	(100)

Figures in brackets show percentages to the total.

Group H - Steel and Aluminium Plants and Rolling Mills.

Group I - Castings and Forgings.

Group J - Mints.

Source : National Council of Applied Economic Research. Demand for Machine Tools, New Delhi, August 1965, pp. 54-55, 56, 57, 60.

drilling machines and presses rank next to that of lathes in the case of electrical engineering (F). Mints (J) and instruments (G) use a very high percentage of lathes, but the total machine tools installed in these industries and their demand for machine tools is likely to be on the low side as compared to other industries. In the case of non-metal based industries and railways, the percentage share of lathes is the highest in the installed machine tools.¹

The shift in demand from lathes and drills to other types may be expected, if in the years to come, the metal-working industries grow faster than railways or non-metal based industries. Before 1955, the demand for the machine tools especially for lathes was mainly from railways.² With the growth of metal working industries during the last decade, the demand for other types besides the lathes, drills and grinders may be generated.

So far, the pattern of past demand for machine tools is analysed in the preceding pages. The examination of expected demand and supply for machine tools in the immediate future forms the subject matter of the following pages.

II

Estimates of the Future Demand for Machine Tools

Two estimates are available regarding the likely demand for machine tools during the Fourth Plan period; one is made

¹ The capital alphabets in the brackets indicate the group shown in the Table 9.8.

² Report of the U.S. Machine Tools Advisory Committee, op.cit., p. 24.

by the Working Group on Machine Tools of the Planning Commission¹ and the other by National Council of Applied Economic Research.²

The Estimate by the Working Group

The Working Group has made several estimates of demand each on different assumptions. These estimates are important in view of the fact that they have been used by the Planning Commission for deciding the targets for the production of machine tools during the Fourth Plan.

The first two of the estimates by the Working Group, given in Table 9.9, are projections of demand based on past consumption. In the second method an estimate of demand for machine tools in the Third Five Year Plan made by the Development Wing in 1960 is compared to the actual consumption during the Third Plan. From 1960 through 1962, the difference between the estimated demand and actual demand was negligible (1.86 per cent). Hence, the future demand is projected assuming the same rate of growth (17 per cent per year) as was assumed by the Development Wing in its projections of demand for the Third Plan. In this estimate, the year 1963,

1 Government of India, Planning Commission, Planning Group on Machinery Industries, Fourth Plan. Report of the Working Group on Machine Tools (Group VI - July 1964). New Delhi, 1965.

2 National Council of Applied Economic Research. Demand for Machine Tools, New Delhi, August 1965.

Table 9.9 : Estimates of Demand for Machine Tools by the Working Group

(Value in Rs. Crores)			
Method	1961-65	1966-70	1971-75
1) Projection of past demand			
1) Eight year period (from 1956 through 1963)	214.01	604.89	
ii) Five year period (from 1959 through 1963)	223.65	750.41	
2) Based on actual consumption correlated with the previous estimate of demand during 1960-65 by the Development Wing:			
1) With 1963 as abnormal		370.50	
ii) With 1963 as normal		866.13	
3) Correlated to Investment in Industry	153.80	340.00	
4) Correlated to capacity of Major Machine Tool using Industries			
1) By value	156.48	346.68	
ii) By numbers	109,000 (Nos.)	173,000 (Nos.)	113,000 (Nos.)
Value of (ii) based on estimated average price during Plan periods	(185.75)	(449.00)	(468.00)

Source : Report of the Working Group on Machine Tools, op.cit., p. 25.

when the difference between the actual and estimated demand was considerably large (41.4 per cent), is not taken into account. When this difference is taken into account, and 1963 is considered to be a normal year, an alternative projection of demand is worked out with the annual rate of growth of 30.1 per cent.

The third method correlates the additional machine tools installed during the First and Second Five Year Plans to the investment in industry during the respective periods, assuming this relationship to be the same during the Third and Fourth Plans. The fourth method correlates the additional machine tools installed during the First and Second Plans to the additional capacity of major machine tool using industries during the respective periods. The average of two ratios when multiplied by the additional capacity (targeted) of the major machine tool using industries during the Third and Fourth Plans respectively gives the additional requirements of machine tools during the respective periods.

The methods used to determine the likely demand suffer from a number of limitations. Simple projections on the basis of past demand assume the same rate of increase in future, with the same average price and productivity of the machine tool.

The third and the fourth methods also assume the same price and productivity of the machine tool. The third method has the limitation that the rate of growth of machine tool

using industries from which the demand for machine generates, is assumed to be the same as the rate of growth in the whole industries sector.

The Working Group prefers the estimate of demand by numbers for purposes of planning the creation and expansion of capacities for machine tool production. The productivity per machine tool (as measured by the ratio of the increase in installed capacity in major machine tool using industries to additional machine tools installed) increased by about 35 per cent during the Third Plan. Assuming the same rate of increase the demand of additional machine tools is determined, given the increase in targeted capacities of major machine tool using industries during the Fourth and Fifth Plans.

The Estimate by the National Council

The National Council of Applied Economic Research uses what is called 'the end-use method' for estimating the future demand for machine tools.

The 'end-use' method consists in (a) identifying all the metal based and non-metal based industries, employing machine tools either for production purposes, training or for repairs and maintenance; (b) listing the output targets or capacities for each of the final products for that future year for which the demand forecast is required; (c) evaluating the requirements of machine tools on the basis of estimated norms; and (d) aggregating the industrywise or the

use-wise figures to give an estimate of the overall requirements of machine tools.

The broad sectors of the economy formed the basis for identifying end-uses of machine tools and for projecting the demand. The norms to evaluate the requirement of machine tools were established from the information collected from the units. The questionnaires sought data from individual units regarding the number of additional machines needed to expand their production by two and three times. From the returns, the average percentage increases needed in each industry for doubling the existing capacities were worked out. These percentages were then applied proportionately to all cases where only expansion of the existing production facilities were contemplated. Where the capacities were created by establishing new units, the ratios between the installed capacities in industries and the installed machine tools in them (based on 1963 inventory) were used for estimating additional requirements of machine tools.

The estimates for the large and medium scale metal working industries were based on the targeted levels of capacity and production proposed by the Planning Commission for achievement by 1970-71.

The replacement requirements of machine tools are based on an average life of 20 years except for capstans, turrets and automatics for which a life of 10 years is assumed.

Thus the additional demand for machine tools for the

entire period of 1964 to 1970 is as follows:

Table 9.10 : Estimate of Demand for Machine Tools by NCAER

(a)	For increased production and maintenance purposes	472,254
(b)	For replacement purposes	45,482
(c)	For exports	650
(d)	For possible non-coverage	7,650
Total		526,036

Source : Demand for Machine Tools, op.cit., p. 21.

In the estimate by the National Council, it is assumed that the Plan targets regarding the capacities of the major machine tool using industries will be fulfilled. This assumption also underlies the estimate of demand by the Working Group. Thus any reduction either in investment or in physical targets of the industries sector, especially of the machine tool using industries, will automatically lead to a reduction in demand for machine tools from what has been estimated. This happens because of the peculiar nature of the demand for machine tools. The demand for machine tools is a derived demand, in the sense, it is dependent on the demand for goods for the production of which machine tools are required. A manufacturer will buy a machine tool either (a) to replace one already in use, or (b) to expand his plant. As the demand

arising out of replacement and maintenance of existing equipment would be comparatively much smaller than that arising out of the expansion of building of new capacities, the expansion of machine tool buying is mainly a product of industrial growth. Any slackening of this rate of industrial growth will affect the demand for machine tools adversely.¹

¹ The following example indicates to what extent the demand for machine tools may rise and fall as a consequence of rather a modest change in the pattern of demand of the product they produce.

It is assumed that in a normal year, a firm produces 1000 locomotives and that for this level of output 500 machine tools are needed. It is further assumed that a machine tool is worn out in 10 years, and the firm will need to replace 50 machine tools each year.

Now it is assumed that the locomotive demand rises by 10 per cent. Then the firm makes 1100 locomotives this year. The total machine tools required as a consequence of this increase in the locomotive demand are shown as follows:

<u>Locomotives demand this year</u>	<u>Replacement demand this year</u>	<u>New machine tools needed</u>	<u>Total machine tools required</u>
1,100	50	50	50

In other words, a 10 per cent increase in locomotives demand brought about a 100 per cent increase in the firm's purchase of machine tools.

Now, it is assumed that the boom in demand for locomotives continues, but somewhat at a slower pace. Thus, the pattern of demand for machine tools emerges in the following manner:

	<u>Locomotive demand per year</u>	<u>Machine tool replacement demand per year</u>	<u>New machine tools needed per year</u>	<u>Total machine tools demand per year</u>
1st year	1,000	50	-	50
2nd year	1,100	50	50	100
3rd year	1,150	50	25	75 *
4th year	1,150	50	-	50

(* With 575 machine tools in use, the number that must be replaced each year rises eventually to 57.5, but this change does not begin to take effect for about ten years.)

(continued)

The likelihood of non-fulfilment of the Plan targets is taken into account by Dr. Lokanathan in his preface to the NCAER Report, but he only assures, "..... if there is a lag in production, all that can happen is that the present estimated demand may be phased over a longer period than computed here (in the study). Also, this lengthening may not make much difference, for what is more important in long term planning is that machine tools, like power and transport, have got to be well in advance of actual requirements." ¹

However, the outcome of under-fulfilment of set targets of demand from machine tool using industries is likely to be more severe in its impact on the machine tool industry than what Dr. Lokanathan seems to suggest. It is important for the machine tool manufacturer to know the demand for a specific period accurately, to make provision for resources, both financial and technical, to manufacture the required quantity of machine tools. If the demand does not materialise, the machine tool industry will be hit adversely, with the

(Footnote from last page continued)

In other words, the downward fluctuation in the machine tool demand begins, while the total demand for locomotives is still rising (illustrated above by the change in the demand for the third year above that for the second); and if the demand for locomotives falls below the normal, so that the firm needs to make only 900 locomotives one year, the number of replacement machine tools that the firm needs, may well be cut.

¹ Demand for Machine Tools, op.cit., p. viii.

result that many firms, unable to sell their products, will go out of the business or switch to other product lines. Thus it is necessary to determine independently the various rates of growth of various machine tool using industries to arrive at their demand for machine tools. As it happens, the demand forecasts based on Plan targets of machine tool using industries, have become somewhat irrelevant, due to recessionary tendencies in the Indian economy which have adversely affected machine tool using industries and consequently the demand for machine tools.

The Recession in the Machine Tool Industry

It would be worthwhile, at this stage, to discuss the recent recession, which the Indian economy, especially the industries sector is presently passing through; and the impact of this recession on demand for machine tools. It has been pointed out earlier that the demand for machine tools is highly dependent on the demand for the products of the machine tool using industries. The forecasts of demand for machine tools can be irrelevant, if the expected rate of growth of the output of machine tool using industries does not materialize.

The Table 9.11 shows the indexes of industrial production in various sectors of the Indian economy from 1963 through 1966. As the average indexes of industrial production for 1967 were not yet published at the time of writing, the indexes for November 1967 are presented, along with those of November

Table 9.11 : Index Numbers of Industrial Production

	Calendar year average (Base 1956 = 100)				Base 1956=100 November		Per cent variation of			
	1963	1964	1965	1966	1966 (Nov.)	1967 (Nov.)	(2) over (1)	(3) over (2)	(4) over (3)	(9) over (8)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
General Index	167.3	177.8	188.1	192.6	195.9	197.3	+ 6.3	+ 5.8	+ 2.4	+ 0.7
Mining and Quarrying	176.1	169.1	184.3	190.4	187.7	180.3	(-) 4.0	+ 9.0	+ 3.3	(-) 3.8
Manufacturing	162.9	173.6	182.3	186.0	185.2	185.0	+ 6.6	+ 5.0	+ 2.0	(-) 0.1
Food Manufactur- ing Industries	121.8	132.8	142.7	147.8	123.1	122.3	+ 9.0	+ 7.5	+ 3.6	(-) 0.6
Textiles	123.1	130.2	130.6	124.9	126.5	128.4	+ 5.8	+ 0.3	(-) 4.4	+ 1.5
Paper and Paper Boards	226.8	237.8	255.4	281.7	282.4	311.1	+ 4.9	+ 7.4	+ 10.3	+ 10.2
Chemicals and chemical products	219.7	238.8	253.1	262.4	265.3	286.5	+ 8.7	+ 6.0	+ 3.7	+ 8.0
Basic Metal	294.4	292.4	300.9	318.0	320.0	307.6	(-) 0.7	+ 2.9	+ 5.7	(-) 3.9
Iron and Steel basic industries	312.7	309.9	320.4	340.8	340.1	310.0	(-) 0.9	+ 3.4	+ 6.4	(-) 8.9
Metal Products	201.0	218.9	239.8	221.5	209.2	207.1	+ 8.9	+ 9.6	(-) 7.6	(-) 1.0
Machinery except electrical machinery	367.2	414.9	489.7	530.1	520.6	337.6	+ 13.0	+ 18.0	+ 8.2	(-) 35.2
Electrical machinery and appliances	239.1	276.1	313.2	340.6	365.4	389.2	+ 15.5	+ 13.4	+ 8.7	+ 6.5
Transport Equipment	150.6	190.2	206.6	187.5	190.1	165.2	+ 26.3	+ 8.6	(-) 9.2	(-) 13.1

Source : Government of India, Central Statistical Organisation (Industrial Statistics Wing), Department of Statistics: Monthly Statistics of the Production of Selected Industries of India for November and December 1967. Calcutta.

1966, for purposes of comparison. Though all the indexes in 1966 show increase over those in 1963, the percentage rate of yearly increase has been decreasing. The impact of recession is seen to be felt from 1965 onwards. The percentage rates of change in indexes for all industries except paper and paper board industry, during 1965-66 is less than those during 1964-65. In textiles, metal products and transport equipment, the production in 1966 is less than that in 1965. The indexes in November 1967 for mining and quarrying, manufacturing sector (as a whole), food manufacturing industries, basic metal and iron and steel industries, machinery industries except electrical machinery and transport equipment were lower than the corresponding indexes in November 1966.

The significance of this recession, in view of demand for machine tools, is more clearly brought out, when production trends in some machine tool using industries during this period are analysed. The Table 9.12 presents the monthly average production of some machine tool using industries from 1963 through 1966. It is seen that in most industries, the percentage increase in production during 1966 over that during 1965 is less than the percentage increase of 1965 production over that in 1964. Diesel engines, industrial boilers, textile machinery, railway wagons, jute machinery are particularly hard hit by the recession in 1966. The recession continued well into 1967. The production figures of only textile machinery, sugar mill machinery, ball bearings, typewriters,

Table 9.12 : Production Trends in Some Machine Tool Using Industries (Monthly Average)

Unit	Year						Percent Variation of				
	1963	1964	1965	1966	1966 (November)	1967 (November)	(2) over (1)	(3) over (2)	(4) over (3)	(6) over (5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Agricultural Machinery (Tractors)	Nos.	136	226	526	634	545	847	+ 66	+ 132	+ 20	+ 55
Earth moving Machinery (Road rollers)	"	73	91	94	91	94	81 ^{a/}	+ 25	+ 3	(-) 3	(-) 14
Diesel Engines (Vehicular)	"	753	686	723	586	586	257	(-) 9	+ 5	(-) 19	(-) 56
" " (Stationary)	"	4629	5844	7323	8918	9546	4536	+ 26	+ 25	+ 21	(-) 52
Industrial boilers (vertical)	Rs. in Lakhs	1.18	1.77	2.25	0.56	1.09	0	+ 50	+ 27	(-) 79	(-) 100
Textile machinery (except shuttles)	Nos.	731	696	606	435	258	309	(-) 5	(-) 13	(-) 28	+ 20
Sugar machinery	Rs. in Lakhs	47.8	67.2	66.2	71.6	15.1	24.2	+ 41	(-) 1	+ 8	+ 60
Cement mill machinery	"	8.28	17.85	40.90	46.26	22.70	18.61	+ 116	+ 129	+ 13	(-) 18
Conveyors	"	13.90	16.50	22.83	37.65	43.76	32.11	+ 19	+ 38	+ 64	(-) 27
Power driven pumps	Nos.	13400	14500	18800	24500	24600	19300	+ 8	+ 30	+ 30	(-) 22
Ball and roller bearings	Nos. in Lakhs	4.13	4.90	6.87	7.67	6.80	8.06	+ 19	+ 40	+ 12	+ 19
Air compressors	Nos.	249	270	230	283	264	32	+ 8	(-) 15	+ 23	(-) 88
Machine Tools (Total)	Rs. in Lakhs	149.88	197.84	237.46	282.90	282.20	164.15	+ 32	+ 20	+ 19	(-) 42
" " (Metal working)	"	135.00	157.74	188.77	219.96	213.65	102.66	+ 17	+ 20	+ 16	(-) 52
Sewing machines	Nos.	28850	21280	35121	34245	26330	22590	(-) 26	+ 65	(-) 2	(-) 14
Typewriters	"	3533	3667	3428	3462	3223	3432	+ 4	(-) 7	+ 10	+ 3
Electrical motors	"	15200	17400	22200	25300	22700	23500	+ 14	+ 27	+ 14	+ 4
Power Transformers	Thousand K.V.A.	219.1	276.0	359.9	399.5	429.3	403.9	+ 26	+ 30	+ 11	(-) 5
Railway wagons	Nos.	1599	1969	2089	1391	1269	799	+ 23	+ 6	(-) 33	(-) 37
Motor vehicles	"	4358	5595	6049	6033	6175	5738	+ 28	+ 8	-	(-) 7
Motor-cycles, Scooters	"	2073	2825	3467	3773	4445	4770	+ 36	+ 23	+ 9	+ 7
Bicycles	"	97135	115005	129008	139208	146563	129812	+ 18	+ 12	+ 8	(-) 11
Hacksaw blades	Thousand Nos.	17.9	24.4	26.0	14.9	16.0	21.1	+ 36	+ 7	(-) 43	+ 32
Jute machinery	Nos.	71	47	35	25	20	20	(-) 34	(-) 26	(-) 29	0
Tea machinery	Rs. in Lakhs	13.59	6.34	9.98	9.67	5.60	4.51	(-) 53	+ 57	(-) 3	(-) 19

a/ For October.

The dash indicates that the figure is less than 0.5.

Source : Government of India, Central Statistical Organisation (Industrial Statistics Wing), Department of Statistics. Monthly Statistics of the Production of Selected Industries of India for November and December 1967. Calcutta.

electrical motors, and motorcycles, and scooters in November 1967 showed positive increase over the corresponding production figures in November 1966.

The decrease in the rates of growth from 1963 through 1966, in the case of machine tool using industries has affected the demand for machine tools industry. The Table 9.12 indicates that though the absolute quantity of production of machine tools increased during this period, the percentage rate of increase has decreased. It is reported that the sales have decreased and stocks are going up. It can be expected that the production of machine tools may also decrease during 1968, as many of the firms have switched to other lines or have gone out of business, with adverse effects on the supply position.

Supply of Machine Tools in the Fourth Plan

The yearwise estimates of demand for machine tools worked out by the NCAER and the Working Group are given in the Table 9.13, along with the actual production and imports from 1964 through 1967.

It is seen from the Table 9.13 that the actual demand for machine tools in India is much lower than that estimated by the NCAER for the period of four years from 1964 through 1967. The estimate of demand by the Working Group for 1966 tallies more or less with the actual demand in that year. In 1967, however, both the indigenous production of machine tools and imports have gone down and decrease in actual demand in 1967 over that in 1966 has been of the order of 50 per cent.

Table 9.13 : Yearwise Estimates of Demand and Actual Demand

(in Numbers)

Year	I NCAER Estimate	II Working Group Estimate	III Imports	IV Indigenous Production	V Actual Demand II+IV
1964	31,599 (75.2)	-	10,399	13,370	23,769
1965	37,650 (63.7)	-	8,552	15,423	23,975
1966	44,450 (62.3)	26,700 (103.8)	12,937	14,679	27,706
1967	53,450 (26.6)	30,200 (47.2)	7,389	6,853	14,242
1968	62,350	34,100			
1969	71,350	38,500			
1960	71,350	43,500			
Total	348,499	173,000			

(Figures in brackets show percentage of actual demand to the estimated demand.)

Sources : Demand for Machine Tools, op.cit., p. 23; Report of the Working Group on Machine Tools, op.cit., p. 29; Indian Machine Tools Manufacturers' Association, 21st Annual Report 1966-67, pp. 23, 24 (for production upto 1966); and IMTMA, Production Returns for 1967, mimeographed (unpublished); Monthly Statistics of the Foreign Trade of India

It is difficult at this stage to assess the production trends of the coming two or three years. However, the findings of the survey, conducted by the Indian Machine Tool Manufacturers' Association in 1967 to assess the nature and extent of the crisis in the machine tool industry, indicate that the manufacturers are not optimistic about the business prospects in the immediate future.

The Association collected information from its 42 member firms regarding output, orders, employment, availability of raw materials, cost of production and selling price, utilization of capacity for the six month period from January to July 1967. Some of the major findings of the survey are as follows:¹

Nearly 60 per cent of the units reported decline in the level of their output. Only 30 per cent of the units could maintain their output at the same level during the six months period from January 1967 to July 1967. This fall in output was related to the rate of incoming orders. Eighty per cent of the firms reported a decline in incoming orders.

Almost all units had to keep their output below the rated capacity. Utilization of production capacity of these units varied from 25 per cent to 75 per cent, making the

1 Indian Machine Tool Manufacturers' Association, Bombay. 'Problems of Recession - Survey of Industrial Trends,' 21st Annual Report 1966-67, pp. 7-11.

average utilization of 54 per cent. The main reason for this idle capacity was the slump in demand and lack of sufficient orders.

As a result, the manufacturers were faced with problems of accumulated stocks due to the conditions created by the recession. The percentage of accumulated stocks to their annual production varied from 15 per cent to 50 per cent. The average of accumulated stocks to production worked out to 30 per cent for all reporting units. Had the utilization of the capacity been greater, the stocks with the manufacturing units could have been much larger.

The findings of the survey indicate that the manufacturers, considering the state of demand, are wary of stepping up their annual production, and they are not inclined to invest substantially in the development of new untried products. Lack of optimism on the part of the manufacturers was reflected in their plans for capital expenditure in the year 1967-68 on buildings, plant and machinery. With the exception of two units no capital expenditure was envisaged by them.

Most of the units, who had machine tool production as a side line, have switched on to other products. Even the major machine tool companies have postponed their plans for expansion. The HMT has deferred its plan of 'one machine tool factory a year' contemplated in the Fourth Plan, till the demand picks up.¹

¹ Hindustan Machine Tools Ltd., Bangalore. Annual Report 1966-67, p. 9.

Next to the problem of insufficient orders, the difficulty in getting adequate credit facilities is hindering production. The cost of finance is also high.¹ Other factors, mentioned by the units, which are likely to hinder the progress of the industry in the immediate future are the dearth of trained workers and supervisory staff, absence of balancing plant and uncertainty in economic outlook.² The situation regarding the availability of imported and indigenous raw materials and other materials was found to be satisfactory, probably as a result of reduced demand for raw materials and components because of the slow-down in the production rate.³

One time-honoured device for levelling out cyclical fluctuations in home demand is to seek harder for export outlets to fill in home demand troughs. The Government of India allows cash subsidy of upto 20 per cent on the value of the exported machine tool, depending upon the type exported, but only 25 per cent of the units surveyed, have been able to avail themselves of the cash subsidy on exports. The survey mentions the following factors, which limit export promotion ability, in order of priority: high prices of the Indian machine tools as compared to those of foreign

1 Problems of Recession - Survey of Industrial Trends, op.cit., p. 8.

2 Ibid, p. 8.

3 Ibid, p. 8.

competitors; lack of selling facilities abroad, inadequate quality of the Indian machine tools as compared to those of foreign competitors, credit or finance for the manufacturer, and the credit for the purchaser.¹

The Industrial Development Bank of India has applied its scheme of refinancing deferred payments, to the machine tool industry with a view to solve the problem of credit to purchasers, but only 20 per cent of the units could take advantage of the facilities offered under the scheme. Most of the units could not avail themselves of the facility because of the difficulty in getting bank guarantee required.² The acceptance of insurance guarantee in place of bank guarantee by the IDBI is proposed by the Association.

About 50 per cent of the actual demand for machine tools during 1966 and 1967 was met by imports. It means that though for certain types the supply was in excess of demand, many items are not yet produced in the country in sufficient quantity. A close study of the types manufactured indigenously indicates that indigenous production was not contemplated for broaching machines, reeling machines, threading and tapping machines. The indigenous production of gear-cutting machines, presses, boring machines was in inadequate quantities. Both licences for boring machines were in the

1 Ibid, p. 11.

2 Ibid, p. 11.

higher price range, whereas a medium or low priced vertical boring machine would have been desirable in view of demand. Though the bench and floor type grinders were fairly well covered, the capacity for heavier floor type and swing type for the foundry industry and that for cylindrical, and internal grinders was inadequate in the context of demand. For most of the types, only certain sizes in certain price ranges were available. The range of sizes of a particular type was not adequately covered. These limitations to the availability of indigenous items of proper sizes and types, is probably the main reason of India's considerable dependence on imports of machine tools.

Shri S. M. Patil predicts that there will be in near future a shift in demand from the general types of machine tools to far heavier types, single and special purpose machine tools including electrically controlled, electro-mechanical, electro-hydraulic machines with mechanical controls, repeat cycle systems, multispindles etc., and machine tools to do specific operations.¹ Similar opinion is expressed by Prof. Thacker, the President of the Central Machine Tool Institute, Bangalore.² In view of postponement of the expansion programmes of many heavy engineering complexes, it seems,

1 S. M. Patil, "Indian Machine Tool Industry," Commerce, Annual Number 1964, Vol. CIX, No.2801, December 1964, p. 155.

2 Prof. M. S. Thacker, "Central Machine Tool Institute and the Machine Tool Industry," Economic Times, 18th September 1966, pp. 4, 6.

however, doubtful that demand in sufficient quantity will materialise for these types during the Fourth Plan.

Various proposals are suggested by experts to combat the recessionary tendencies in the machine tool industry. It has been suggested that the amount of cash subsidy on exports should be increased.¹ A suggestion has been made to insert a clause in the India's loan agreements with other countries, to the effect that part of repayment be made in kind such as industrial machinery, machine tools, etc.² There are other suggestions to the effect that proposed machine tool factories at Bhavnagar and Ajmer in the public sector should not be undertaken in the near future till the demand improves.³ There are proposals that design facilities for complicated machine tools be provided by the Government. Regarding the accumulated stocks at machine tool factories, a suggestion has been made that the Government should copy the example of U.S.A. when, in times of recession, the accumulated stocks were purchased by the Government and were dumped on consumer goods industries.⁴

The problem of recession faced by the industry may be divided into short-term problem of adequate offtake to clear

1 "Anxious Days for Machine Tools," Eastern Economist, Annual Number 1968, December 27th, 1967, p. 198.

2 V. P. Goyal, "Recession in the Machine Tool Industry," MBI's Indian Industries Annual 1967, (published by) S. T. Chary, Bombay, p. 178.

3 Ibid, p. 178.

4 A special correspondent, "Crisis in Machine Tool Industry," Economic Times, 10th July, 1967, p. 9.

accumulated stocks and obtain fresh orders to maintain production at a reasonable level; and the long-term problem of making its product pattern and selling policy more demand oriented.

The immediate steps which could be recommended are the stepping up of production by Government Departments, and special bank advances to machine tool producers against their accumulated stocks. The steps, advocated by various authors, summarized in the above paragraph, may be considered.

The solution of the long-term problem involves more and better forward planning of investment by users of machine tools in consultation with their suppliers and use of operational research and similar techniques to minimise the effects of cyclical fluctuations by facilitating forecasts of market demand and control of production and inventory. Granting investment allowances to user industries, the practice followed in Great Britain after the Second World war, may be considered for improving their demand for machine tools.

The discussion of policies to step up the demand for machine tools may be ended with some words of caution from Wesley Mitchell, who made one of the first studies of the machine tool industry's business cycle problems. He concluded that the machine tool industry is "subject to an increasingly large business cycle hazards larger than in almost any other branch of manufacture" He suggests various

measures such as bringing out improved models in depression, adjusting the price of the machine tool to the saving it will make etc. But he concludes, "..... The upshot of what has been said is that the manufacturer of machine tools has embarked on an extra hazardous voyage, that he can do little to control the storms which assail him with particular violence, and that his best hope lies in joining with his fellows to develop a first class weather reporting service for their common safety. " 1

1 The quotations are from Wesley Mitchell's "The Business Hazard in Machine Tool Industry," American Machinist, January 3rd, 1924, Vol. 60, No. 1, p.2; as quoted by Wayne C. Brohl Jr. in his Precision Valley ; The Machine Tool Factories of Springfield-Vermont, Englewood Cliffs, Prentice Hall Inc., New Jersey, 1959, pp. 106-107.

CHAPTER 10GOVERNMENT POLICY TOWARDS THE GROWTH OF
MACHINE TOOL INDUSTRY

that
It can be said/the development of the machine tool industry in India has been made possible by the policies followed by the Government from time to time. The beginning of the indigenous machine tool industry is mainly due to policies of the then Indian Government and the British War Ministry during the Second World War. Its rapid growth during the Five Year Plans was facilitated by the particular policies of the Government towards the industry and the impetus given to the machine tool making by the programmes of industrial development, especially those of engineering industries. The Government has taken active steps to foster the growth of the machine tool industry, which has been given a 'priority' status, as far as allocation of raw materials and other assistance is considered. Machine tool builders are allowed the tax-concessions, available to industries in the 'priority' group. The manufacturers are given incentives to promote exports of machine tools. Of greater significance to the growth of the machine tool industry are policies aimed at restricting the foreign competition, the licensing policies aimed at developing various types and sizes indigenously, and the policies towards research and development aimed at developing new designs.

Equally important is the decision of the Government to enter the field of machine tool building as a major producer of machine tools. This chapter is mainly concerned with these latter policies which have influenced the quantity and quality of machine tools produced in the country. Following the discussion of the favourable and unfavourable results of these policies for machine tool making in India, the balance of the chapter is concerned with the role of Indian Machine Tool Manufacturers' Association and the Development Council for Machine Tools, in analysing and solving the problems of development facing the machine tool industry.

The Import Policy

The policy of the Government of restricting imports has been extensively discussed in the Chapter 5. When the question of granting protection to the indigenous machine tool industry was considered in 1949, the Panel of Machine Tools felt that, a uniform rate of protective duty might not be desirable, as the products are heterogenous in nature and the cost-price structure of a particular product is much different than that of the other. Thus a revenue duty was imposed on, with the additional provision that the machine tools which are indigenously manufactured cannot be imported.¹ Every year, the new types and sizes are added to the list of

¹ The Report of the Machine Tool Panel, op.cit., Chapter 1. Recommendations pp. 11-12.

banned machine tools. It has been also shown earlier how the landed cost of an imported machine tool is inflated to about twice its f.o.b. price after the payment of the duty and other charges.¹ These measures have contributed to the restriction of foreign competition.

Efforts by the Government to encourage the development of the indigenous machine tool industry by reserving for it a major part of the domestic market have met with mixed success in the past. During the period covered by the three Five Year Plans, the indigenous production increased from Rs. 47 lakhs in 1951 to Rs.2491 lakhs in 1966. In 1951, most of the machine tools indigenously manufactured were general types of lathes, drills, shapers etc., while in 1966 precision and heavy machine tools and other special-purpose machine tools were being manufactured. In contrast to these indications of significant progress, other less favourable aspects may be considered, which include the failure of the firms to produce products of undisputed quality and the inability of the industry to dispense with the Government restrictions on imports. At the same time, the indigenous production of several classes of machine tools has been found to be insufficient to meet the heavy backlog of demand and the imports have been continuously rising. When the question of probable impact of dispensing with the restrictions

1 Chapter 5, p. 141.

on import of machine tools on the indigenous manufacturers was, discussed with machine tool builders, selling agents and government officials, the unanimous opinion seemed to be that the industry will suffer a setback and chaos in the domestic market will be created as a consequence of such a course. Only the minority of more efficient firms would be able to face the external competition and even these firms would be obliged to change their methods of production and sales drastically. It is also believed that the manufacture of items of sophisticated designs may not be taken up due to the competition of similar imported items of better quality, if duty on them was drastically reduced.

However, the inability of the indigenous manufacturers to do away with the Government policy of restriction of imports does not imply the conclusion that the Government's decision to foster the growth of indigenous machine tool industry by banning the imports of machine tools which are indigenously manufactured, was in any way unwise. Without such a policy, the growth of indigenous machine tool industry could not have been facilitated. The growth of indigenous production has led to the saving of foreign exchange and has, to some extent, freed the country from its dependence on external sources for the supply of a vitally needed commodity.

Nevertheless, the Government policy of restricting imports, has, in the past, allowed indigenous manufacturers

to operate in the sellers' market.¹ Thus there has been little stimulus to make them intimate methods for rationalizing production, adopting better technology and cost-saving devices. Unless the indigenous machine tool builders are faced with the prospect of working under relatively competitive conditions, it is unlikely that they will ever become really conscious of cost and quality. Hence it is felt that it is unwise to continue restrictive policies towards imports for an indefinite length of time. When to abolish this policy, will of course depend on supply and demand conditions in the home market over the coming years. It would have also to be considered for what types and sizes of machine tools, this policy of banning imports has to be relaxed. A sudden reversal of the policy may perhaps compel some firms to produce the products at a lower cost and price but at the same time discourage them from investing in the development work of untried products, in which the firms have not yet secured strong market positions.

It is believed that the gradual removal of restrictions on imports of machine tools will foster the competition in the domestic machine tool market. The stimulus to the competition, however, need not be an external one exclusively.

¹ The situation is somewhat changed since 1965, when the machine tool industry has been suffering from recession and the demand is much less than the supply. The recovery and the resultant increase in demand, may again give the manufacturers a strong position in the market as it happened after the recession in 1950-51.

The indigenous manufacturers are also likely to be challenged by one another's products, to strive after better performance, though perhaps to a lesser extent than in the case, when the competition is from established foreign manufacturers. The licensing policy has an important role to play in stimulating internal competition.

The Licensing Policy

The history of the licensing policy for machine tools has swung from one extreme to the other in the past. The Thacker Committee initiated the policy of the rationalization of the production of machine tools in 1956. Under this scheme of rationalization, different units specialized in particular types of machine tools. For example, Cooper was to build shapers; Mysore Kirloskar was to manufacture certain types of lathes, etc.¹

The recommendations of the Thacker Committee were not incorrect in the light of circumstances existing in 1956. Due to the stress on development of medium scale and heavy industry in the Second Five Year Plan, it was felt that quality machine tools in adequate supply were required. That the existing few units at that time should not fritter away their resources in diversifying their production to a needless extent, thus producing neither an adequate quantity

1 The Final Report of the Machine Tool Committee 1956. (This Committee is known as Thacker Committee, after the name of its chairman, Prof. Thacker.) op.cit., Chapter 1. Recommendations pp. 14-15.

nor improving the quality of their products, the Thacker Committee sought to utilize the existing capacity to its fullest extent by means of the policy of allowing the units to specialize in particular products.

By the beginning of the Third Five Year Plan, the situation had, however, altered. The recommendations of the Thacker Committee had given a few manufacturers almost monopolistic positions regarding certain particular items. There was an acute shortage of machine tools, particularly of general types of medium size, while the demand for machine tools was expected to go up substantially during the Third Five Year Plan due to the increasing stress on industrialization of the country.¹ Thus, the deliveries quoted by the indigenous manufacturers became more and more protracted and the users had to wait for months for supply. This led to a mounting pressure on imports.

A major part of the increase in imports during the Second Five Year Plan can be attributed to the faulty execution of the recommendations of the Thacker Committee. Since the manufacturing programme of particular machine tools was earmarked to specific units, no choice was left to consumers in respect of types and sizes, if the particular manufacturer produced items only of certain sizes. Hence, even granting

1 B. D. Kalelkar. A Review of Machine Tool Industry. Development Wing, Udyog Bhavan, New Delhi (mimeographed), January 1961, p. 2.

the preference for imported machines, there was some justification of imports on technical and financial grounds. For example, in respect of lathes, it should normally be possible to obtain machines of the same physical dimensions in various price ranges, depending upon design features. While very high precision lathes were available at more than Rs. 30,000 each, the next choice was a cone-pulley lathe costing less than Rs. 10,000. There was practically no machine to be offered to the customer, who wanted a medium duty lathe costing about Rs. 15,000.¹

Thus reviewing the situation in 1959, the Development Council for Machine Tools recommended the Government of India that "on account of the huge demand of machine tools at present and the further heavy demand expected in the Third Five Year Plan, the specialization of different units in particular types of machine tools contained in the (Thacker Committee) report, need not be the sole guiding factor in creation of additional capacity for manufacture of machine tools."² The Council was of the opinion that "many more units should be brought about for manufacture of machine tools, and therefore, the Government should liberalise the procedure for licensing under the Industries Act for the manufacture of machine tools."³

1 Ibid, p. 3.

2 The Minutes of the Meeting of the Development Council for Machine Tools on 6th November 1959.

3 Ibid.

This proposal by the Development Council was accepted by the Government soon after it was recommended. According to the new policy, "every unit in the private or public sector was to be allowed to expand in any category of machine tools that they desired to produce irrespective of whether a machine is being produced in any factory or factories in public or private sector."¹ Once the capacities were created, the diversification was expected to take place.

Since 1960-61 onwards, many new units were established, or expansion of the old units took place. The Table 5.2 in Chapter 5 indicates that there have been a number of manufacturers, producing such items as lathes, drilling machines, shapers, etc. A degree of competition is infused in the market for such items as a result of the change in the Government policy of liberalization of licensing. Nevertheless, the role of competition, especially through price cutting, is relatively limited in the market for machine tools, as there is always a scope for product diversification and it is difficult to dislodge the established manufacturers from their strong market positions. Though the chances of prices being lowered are rare, a vigorous product competition, nevertheless, obliges the manufacturer to improve the quality of his products and improve the after sales service. Nevertheless, while general types of machine tools are indigenously

¹ The Minutes of the Meeting of the Development Council for Machine Tools on 5th January 1960.

produced in a quantity exceeding demand, no capacities are created for certain classes of machine tools. Thus size range of a particular type or various types of a particular product is not adequately covered, by the policy, so that customers have not got a larger area of choice.

It appears that in eliminating the adverse effects of the recommendations of the Thacker Committee, the licensing authorities have reached the other extreme point. For general purpose simple types of machine tools, there is a very keen competition, while for items of advanced types, a few firms still enjoy monopolistic positions. For the policy to be really effective, a delicate balance has to be kept between these two extremes, and the policy should be executed in such a way that both undue competition or monopoly for any of the items is avoided.

The role of the licensing policy in promoting the development of heavy machine tools, special purpose machinery and electrically controlled, numerically controlled machine tools, etc., is equally important. The licensing policy, however, cannot do much in this respect by itself. The choice of a project from the point of view of a manufacturer, is necessarily dictated by the rate of return on the investment. The uncertainty whether the expected demand would materialize, deters him from taking the risk of incurring heavy development costs of building sophisticated machine tools, even if his resources allow such a venture, which

they rarely do, especially in the case of a manufacturer in the private sector. It is not sure whether even extremely liberal fiscal concessions like higher rate of price-subsidy, tax exemption on development costs for a longer duration, would entice a private manufacturer to invest in an uncertain project, when other more profitable avenues are open.

The Government, mainly for this reason, has assumed the role of the producer of machine tools since the beginning of the First Plan. To the list of NMT, Praga, Ambarnath Prototype, the three companies in the public sector, is added the machine tool division of the Heavy Engineering Ltd. at Ranchi. There are plans to start new factories at Bhavnagar and Ajmer. The entry of the Government in the machine tool business and the attitude of private sector manufacturers to the Government's role as a producer have been discussed in the next section.

The State as a Manufacturer of Machine Tools

The decision of the Government of India to assume for itself the role of the manufacturer of machine tools was made clear in the Industrial Policy Resolution of April 1956. The machine tool industry was included into the category of industries "which will be progressively state-owned and in which the State will generally take the initiative in establishing new industries, but in which the private enterprise will also be expected to supplement the efforts of the State."¹

¹ The Government of India, Planning Commission. The Second Five Year Plan. New Delhi, p. 23.

The decision to start a machine tool factory by the State was taken much earlier, before the beginning of the First Five Year Plan. The range of products of the industry, as it then existed, included mostly copies of the models of lathes, drilling machines, shaping and planing machines and chucks. Much more advanced types and sizes were required for the development of heavy industries. According to the Planning Commission, "These indigenous machine tools had not been found suitable for Class I Railway Workshops, Ordnance Factories and certain other key industries, where the manufacture is essentially on production basis and where floor to floor time is fixed for each article to be machined and the production series cover large numbers and have to be completed economically within the shortest possible time."¹ The Planning Commission then further analysed the characteristics of the market for machine tools then existing in India. "The market in India needs a large number of small size general purpose machine tools required for the development of the industry, in the thousands of small workshops scattered all over the country. But the greater portion of the expenditure is incurred on machine tools covering production, precision and heavy duty machine tools such as capstan and turret lathes, semi-automatics and automatics, heavy milling machines, plano millers, plano grinders and wide variety of

¹ Programmes of Industrial Development 1951-56, op.cit., p. 54.

high speed and heavy duty machines without which it is not possible to step up industrial production. The third market is for certain special purpose machine tools which are always required by the heavy industries such as ordnance factories, railways, shipyards and industries like steel, automobile, aircraft, etc."¹ The Government intended to confine its activities in the second and the third market.

The entry of the Government in the machine tool production gave rise to a kind of suspicious attitude on the part of machine tool builders in the private sector towards the HMT and its role. Even when the idea of a machine tool factory in the public sector was being discussed, the private sector industrialists were apprehensive about such a move on the part of the Government. Sir A. P. Ramswami Mudliar said at the convention of Indian Machine Tool Manufacturers' Association in January 1949, "There has been a great controversy (over the machine tool factory in the public sector). That during the last six months, there has not been even one single application for capital issue (from manufacturers of machine tools), is an eloquent proof of the state of industrialists' minds."² Though Shri M. B. Jambhekar, the President of the Association, welcomed "the

1 Ibid, p. 56

2 Sir A. P. Ramswami Mudaliar, Dewan of Mysore - Address to the Convention of Indian Machine Tool Manufacturers' Association on 11th January 1949 at Bangalore.

proposal from the national point of view", he hoped that "the Government will plan production in such a manner that a sufficiently large field is left for private enterprise to work in as the latter has already sunk in a large investment and labour (in the industry)." ¹

During the last several years, at least upto 1965, the machine tool manufacturers enjoyed a sellers' market and were not much bothered by the competition from the other producers of similar products. The HMT did not compete in the market for simple types of machine tools. Thus the apprehensions of manufacturers in the private sector regarding the impact of competition from the HMT on their products, have, by and large, did not materialize. Nevertheless, the suspicious attitude of the private sector manufacturers towards the HMT has not much altered. The criticism regarding the alleged preferential treatment given to the HMT by the Government in various matters, such as licensing of new products, procurement of raw materials, orders from the D.G.S. and D. and other government departments is voiced by the machine tool manufacturers in the private sector. Shri S. L. Kirloskar remarked "The attitude of the Government, (to the private sector) seems to point towards a

¹ M. B. Jambhekar, the President of the Indian Machine Tool Manufacturers' Association - Speech made at the Second General Meeting of the Association held on 11th January 1949, at Bangalore.

'closed door' policy, motivated, perhaps, by a strange feeling of doubt and distrust towards the private sector." ¹

It is very difficult to substantiate such allegations in the absence of data regarding the policy of discrimination. The attitude of open or concealed opposition by the private sector manufacturers to the entry of the Government in the manufacture of machine tools which was prevalent at the beginning of Five Year Plans, however, seems to have changed to that of an acceptance, though a reluctant one, of its continued existence in the machine tool business. It cannot be denied that the HMT contributed substantially to the indigenous production of machine tools. During the last seven years, the share of the public sector (the HMT factories and Praga Tools) in the indigenous production of machine tools amounted to about 50 per cent of the total. When all the ten factories of the HMT and the Machine Tool Division of the Heavy Engineering Complex at Ranchi go into production, this share is likely to increase still further. The HMT has developed the manufacture of heavy and special purpose machine tools, the items which the private sector manufacturers would have been reluctant to develop either for want of funds or the uncertainty of marketing these products.

¹ S. L. Kirloskar - Speech of the President at the Seventeenth Annual General Meeting of the Association held at Ludhiana on Saturday, February 22, 1964.

The private sector manufacturers seem to be afraid that HMT may start manufacturing such items as are produced by them. Though the development of specialized machine tools which could not be easily manufactured in the private sector seems to be the primary role of the machine tool factories in the public sector, it is neither possible nor desirable, in the writer's opinion, for the public sector factories to confine themselves to this work alone. The demand for heavy duty and special purpose machine tools is much smaller in quantity at the present stage of India's industrialization as compared to the demand for small and medium sized general purpose machine tools. To cater to this demand and also to show a profitable business, the public sector machine tool factories have to start the manufacture of some of the general purpose machine tools. The HMT has done so in the past. That the public sector factories should continue to manufacture both medium size general purpose machine tools along with the development work on specialized items, seems desirable in that, the resulting product competition with the private sector machine tool manufacturers would give impetus to the improvement of the quality of products and the introduction of new design features.

Research and Development

The area in which the Government can do much to improve the quality of indigenous machine tools is encouraging the research for the development of better designs and new types.

During the Second Five Year Plan period, the Ministry of Commerce and Industry of the Government of India, set up a Committee to look into all aspects of research, designing and development of machine tools. It was due to the recommendations of the Committee that the Central Machine Tool Institute was planned with the financial and technical collaboration of the Government of Czechoslovakia. The Central Machine Tool Institute was registered as a society in Bangalore in March 1962 and is under the administration and control of the Ministry of Steel and Heavy Industries. The main objective of the Institute is to develop new designs and to conduct research on machine tools and allied subjects.¹

Though the Central Machine Tool Institute can provide new designs and develop new products in order to sell them later on to the private industrialists, it is also essential that the continuous research work can go on in the individual units. While the plan to set up the Machine Tool Institute at Bangalore was being considered, a view was taken by the representatives of the private sector of the Industry, that the immediate need of the machine tool industry was to solve day to day production problems on the shop floors of the manufacturing units.² In effect, this view implied that

1 "Machine Tool Institute," Machine Tool Engineer, Vol.IV, No.3, July-September 1963 (published by) Hindustan Machine Tools Ltd., Bangalore, p. 31.

2 Minutes of the Meeting of the Development Council for Machine Tools - 6th November 1959.

the funds earmarked for the design Institute be made available to the individual units. Without, however, subscribing to this view, it can be urged that the skeleton design cells should also be established in individual units which will be conversant with the intricacies of designs of existing models manufactured in these units, and can solve the problems encountered in the course of manufacturing of these models, such as, the problems of adopting simpler workshop techniques, introducing indigenous counterparts for the imported ones, designing of entirely new machine tools when sufficient experience is gained on these lines.

At present few large scale units have established their own design cells, which are performing some of the above-mentioned functions. The lack of sufficient funds is said to be the main difficulty for the manufacturers in the private sector to devote enough attention to research and development. In this respect, the machine tool builders can be given positive financial and technical help by the Government. Similarly, more tax concessions to individual units for their expenditure on research are justified. In addition to this, the co-ordination between the 'Research Co-ordination, Industrial Liaison and Extension Unit' and the 'Directorate of Technical Development' of the Government of India and its representation on the Licensing Committee of the Ministry of Industry requires to be further strengthened for restricting foreign collaboration only to those items for which Indian

technical know-how is not available. It is also essential that the machine tool manufacturers should themselves form research associations to solve their own problems, on the lines of ATIRA (Ahmedabad Textile Industry's Research Association), SAMIRA (Silk and Art Silk Mills Research Association), etc.

The Indian Machine Tool Industry is made up of many firms, which are independent and individualistic, hence it is difficult to persuade them to impose on themselves any programme of industrywise standardization and rationalization of designs.¹ For the rapid development of the industry standardization and simplification of components would be of great benefit to the industry. In Germany, standardization was imposed on the machine tool industry by the decree of Hitler. Similarly in Russia, machine tool designs were standardized in the regime of Stalin.²

1 A similar state prevailed in the American Machine Tool Industry in early fifties. The Report of the Anglo-American Council on Productivity notes, "The state of affairs reminds one of the early days of bicycle, when every manufacturer had his own designs and standards for all his components, so that practically no part of one bicycle, not even a nut, could be used as a spare for another make of bicycle; it was stated mischievously that this was a deliberate attempt to ensure that the making firm received all the orders for spares of its own make of bicycle." From Anglo-American Council on Productivity: Metal-working Machine Tools. London S.W. 1, January 1953, p. 48.

2 Ibid, p. 48.

Though, drastic steps of imposing standardization and simplification in India by the decree of the Government seem to be not probable, the Government can, through persuasive efforts, help the manufacturers to advance in this direction. The need for standardization is felt by manufacturers, government officials and experts in the industry.¹ The large users of machine tools, by virtue of their market position, can force the industry to a degree of standardization, as they have done in U.S.A.²

So far, the discussion is confined to certain aspects of the Government policy towards the problems of development of the machine tool industry in India. The remaining pages sum up the role of the two institutions, which can detect, and analyse these problems, and convey the suggested solutions to the Government authorities.

The Indian Machine Tool Manufacturers' Association

Various problems confronting the machine tool industry such as the co-ordinated planning of production programmes, setting up the standards of manufacture, encouraging the development of better designs, organizing publicity to

1 Minutes of the meetings of the Development Council. Similarly the inaugural address by Shri Venkatraman, member of the Planning Commission, at the Twentyfirst Annual General Meeting of the Indian Machine Tool Manufacturers' Association at Madras on January 22, 1968. He stressed the need for standardization to maximize production and minimize costs.

2 Metal-working Machine Tools, op.cit., p. 48.

popularize the indigenous machine tools etc. can be solved better by machine tool manufacturers in the country acting in their corporate capacity than by isolated and individual efforts. The machine tool manufacturers in industrially advanced countries have developed strong associations to deal with these problems, and these associations act as powerful lobbies to represent the views of the manufacturers to the governments of these countries.¹ Similarly, a united and organized effort on the part of Indian machine tool manufacturers would be of considerable help to analyse and solve the problems of the machine tool industry in India.

With this purpose, the Indian Machine Tool Manufacturers' Association was started in 1946 by six leading manufacturers of machine tools who met in Delhi. Within a year or so of its foundation, nineteen prominent manufacturers of machine tools in India had joined the Association as members. Now the Association has amongst its member firms all the leading manufacturing concerns, and is recognized by the Government of India as the authoritative body representing the Indian machine tool industry. The total membership of the Association stood at 86 in 1966.

The activities of the Association include the circularising of the latest statistical data regarding the imports and production of machine tools in India and other information

1 Ibid.

relating to the development of the industry in India. It maintains a liaison with the Ministry of Commerce and Industry of the Government of India and represents to the Government on behalf of the members, both individually and collectively for the release of raw materials, import licences, etc.

At present, the role of the Association is of a limited nature; and it seems to act mainly as a centre for collecting and disseminating information. The scope of its activities can be increased still further. It can help to plan the manufacture of machine tools in such a manner that all the items within particular size range are produced. It can organize the periodic demand surveys for different types of machine tools and know in advance the direction and shift of demand. For this purpose, the Association can keep a close contact with the associations of major machine tool using industries. The Association can usefully work to encourage the exports of Indian machine tools. In this respect, the Association has already taken some steps by planning to organize a consortia of export houses,¹ to export indigenous machine tools.

The Association, however, is mainly useful as a channel to convey the complaints and demands to the Government. By virtue of the nature of its organization, the Development

¹ Indian Machine Tool Manufacturers' Association, Bombay. Twentyfirst Annual Report, 1966-67, p. 6.

Council is better fitted to work more effectively when the question comes up of considering these complaints and demands and formulating coherent policies.

The Development Council (Machine Tools)

The Development Council for Machine Tools was set up by the Government of India, according to the Section 6 of the Industries (Development and Regulation) Act of 1951. It acts as an advisory body to the Ministry of Commerce and Industry of the Government of India to consider the problems of development of the Machine Tool Industry. In choosing the members of the Development Council, the interests of various parties, such as the organized machine tool sector, the unorganized small scale sector, major machine tool using industries, the Government, are represented. Some independent members are chosen for their knowledge of the industry.

Reading through the minutes of the meetings of the Development Council, one finds the discussion of various problems which the Industry has faced in the past and is facing at present. The problems discussed vary from those of procurement of raw materials, shortage of foreign exchange, export promotion to those of the development of the design institute, development of ancillary industries, development of small scale machine tool units etc. The discussion of the problems probably helps to clarify many of conflicting aspects of a suggested solution. A better

rapport is perhaps established between the representatives of the various interests and the government officials. One finds that many of the Council's recommendations such as for the liberalization of licensing policy, for the establishment of the machine tool design institute later on resulted into executive actions on the part of the Government.

Though attention is called in this chapter to some of the inadequacies of the Government policies towards the growth of the machine tool industry, the Government appears sympathetic to the needs of developing machine tool industry. It is natural that the expectations of private manufacturers would contradict with the trend of thought implicit in policies and actions of the Government. Nonetheless there is no overt or covert evidence on the part of the Government either to monopolize the machine tool production or to restrict private manufacturers unduly. On the basis of the past experience, one expects that the policies of the Government would be favourable to the continuing growth of machine tool industry.

CHAPTER 11SALIENT FEATURES OF THIS STUDY

The role of the Government policy towards the growth of the machine tool industry has been already discussed in the previous chapter. On the whole the policies of the Government have been sympathetic to the development of the industry. Viewed from an overall perspective, machine tool industry, since its inception, is seen to be making a steady, if not spectacular progress, in terms of production and capacity, product designs and technology of manufacture. Whether or not this industry develops its full potential over the next decade or two, it will depend, to a considerable degree, on the foresight and energy displayed by the manufacturers supplemented by the assistance by the Government.

Despite the steady progress, the industry can be said to be still short of satisfactory performance. The resources continue to be inefficiently used, personnel is not well trained, and the possibilities inherent in the rationalized production are only beginning to be explored.

The situation regarding the availability of raw materials was difficult in 1964-65. Afterwards, the situation has improved enormously, partly due to the lack of demand for materials from the manufacturers who have

either curtailed or stopped the production of machine tools. There is not yet systematic attempts on the part of manufacturers, except a few, to help to develop indigenous substitutes for imported materials and components. In this respect, the manufacturers are still dependent on the foreign suppliers and the import policies of the Government.

In the early years, only simple types of machine tools were manufactured. Now indigenous production includes heavy and medium size machine tools, and special purpose machinery, in addition to general types. However, the range of sizes of any particular type manufactured is not comprehensive enough and high proportion of machine tools is still imported.

There is a lack of effective and continuous research and development of advanced designs indigenously, probably because of the high cost of such activity relative to the levels of output of most firms. The company officials also fail to recognize the benefits to be derived from increasing efforts in this direction and the competition is not still stiff enough to persuade the manufacturer of the necessity of having an edge over the manufacturer of similar items. Smaller firms do not afford to do research and larger firms, with a few exceptions, have managed to get by without it.

The manufacturers have complained, somewhat justifiably, that the research at the Central Machine Tool Institute at Bangalore is of little use to them, but they have not felt it necessary to put on efforts on their own. The necessary investment for research is quite feasible on a co-operative basis or even for individual companies as the expanded sales bring in more revenues. The manufacturers still appear to develop new designs with foreign collaboration or buy them outright from foreign manufacturers.

Research in improving the production techniques is also done infrequently. For example, the methods of group technology can be introduced to compensate for the shortcomings of small lot production methods. The components can be standardized and produced on the mass production basis leading to the savings in costs. Obsolete methods, for example, in material handling, can be abandoned in favour of advanced techniques. It often appears that in the production processes, Western techniques are accepted without qualification and at the same time, old familiar procedures are followed without question. Co-existence of highly advanced special purpose machinery and the cone-pulley lathes in the same machine-shop is one example of such a practice.

Not only there is inadequacy in the choice and methods of technology, their use and application are also not

efficient enough. Though there are variations in efficiency of operations from plant to plant, most firms do not pay enough attention to the effective utilization of capital facilities. The maintenance of equipment is neglected, with an inevitable result of broken down machinery and loss of production time. There is a lack of intense interest in obtaining optimum performance from available facilities and seeming unawareness of cumulative significance of a host of minor losses and inefficiencies. The capital facilities are often unbalanced and the absence of vital concern for high standards of maintenance and performance results in under-utilization of equipment.

The most machine tool firms have succeeded in developing a trained labour force mostly from the raw recruits available. Welfare facilities have been provided. Though a relatively stable labour force is built up, the problem of seasonal absenteeism and high turnover are not yet overcome.

Wage rates are not yet standardized, adding to the causes of friction between the labour and the management. Nonetheless, despite a considerable growth of trade unionism in machine tool industry, the industrial relations are relatively more peaceful than in the case of, say, cotton textiles or iron and steel.

To raise worker productivity (other than through the use of better equipment), most machine tool companies have

provided on-the-job training and incentive payments systems. Training programmes tend to be given more lip-service than attention, with a few exceptions. It is not known whether incentive systems have really been able to link up efforts and rewards properly.

Effective utilization of workers depends to a large extent on the quality of supervisors and managerial personnel. The supervisors have been provided on-the-job training by a few companies. In 1964-65, the companies tended to recruit more number of diploma holders and science graduates to the posts of junior supervisors. With the abundant supply of graduate engineers, the policies of the firms are likely to change. Though graduate engineers with their superior theoretical knowledge may be better able to solve practical manufacturing problems and initiate new methods, the advantages may be offset by the frustration inherent in the nature of the junior supervisory job, unless the scales of remuneration are notably improved.

The cadre of the middle management needs to be improved. Similarly the gulf between the production and administrative personnel needs to be bridged, by involving technical persons in administrative and especially financial decision-making. More attention to the techniques of business management is needed, especially in the case of cost accounting, industrial engineering, production planning and personnel administration.

The role of effective marketing may also be noted. At present about 40 per cent of the output of the companies is sold to the Government, for which no special sales efforts are needed, but for the rest, adequate sales efforts are necessary. Upto 1964-65, as long as there was a general shortage of machine tools, the companies could afford to sit back and wait for the orders to pour in. Even now the companies whose products enjoy the best reputation in the market still do so. This is not, however, the best way to push up sales. There is a need for locating and contacting the potential customers. Technical salesmen who can deal directly with the production men at the machine tool factory and the personnel in the consumers' plants may be employed with an advantage. In doing so, the manufacturers themselves may integrate the operations to the distribution stage and avoid the disadvantages of sole selling agency system. If the costs of such an effort are not feasible for an individual manufacturer, co-operative groupings for sales purposes of several manufacturers producing similar types in various size ranges may be suggested.

In evaluating the performance of machine tool companies, one question of fundamental importance recurs. What is the need for the majority of machine tool manufacturers to incur the expenses and efforts in improving their performance, if the present methods of manufacture yield handsome returns, if they can sell their products at a profit, if they think

that conservative methods and policies have seen them well through the past and can be relied upon in future?

This question seemed especially important in 1964-65, when the machine tool makers enjoyed a sellers' market. Since then the recent recession has been to an extent responsible for the manufacturers reviewing their strategy of operations. However, though it is seen that during the last two or three years Indian machine tool making has begun to feel the impact of new ideas and more dynamic operating concepts, there are signs of recovery from the slump, and it is not improbable that the machine tool makers will not again find themselves in the old grooves of thinking and action.

It is the writer's contention that if such a thing is to be avoided, and the machine tool industry is to achieve anything approaching optimum conditions, it needs the stimulus of a more competitive environment. It is necessary to provide the domestic competition through the effective execution of the licensing policy and restrictions on foreign competition should also be gradually removed. The public sector companies, which have mainly responsible for the growth of the industry since 1956, can also have a role in this respect, in addition to the task of building machinery which the private sector cannot do for want of resources. The machine tool manufacturers had a foretaste of the battle for survival during the last two or three years. They have done well in the past; in future they should do better.

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The Comparison of Prices of Indian and Foreign Machine Tools

In Table 5-6 price quotations for some of the Indian machine tools, along with the prices of comparable foreign items are given.

The data for Indian prices are mostly taken from the available published price lists of Indian companies. The price-quotations for few foreign items were available from the published price lists of two companies, Cincinnati U.S.A and Alfred Herbert U.K. These were converted into rupee terms at the proper exchange rate.

Most of the price quotations for foreign items were culled out from the purchase prices for installed machines in four of the machine tool factories. It is assumed that the purchase price for a machine paid by the Indian manufacturers ^{is} are roughly one hundred and fifty per cent of the ex-factory price of the machine in its home country. In some cases, especially for advanced types, the purchase price for Indian manufacturers is twice the ex-factory price of the machine. The ex-factory prices for foreign items were derived accordingly. In some cases (for example, the price of collaborator's model of equivalent capacity) were obtained, mostly as rough guesses, from the manufacturers themselves.

Prices for Indian items and their corresponding makes were not available for the same year. The price-quotations for foreign items are mostly available upto 1956. Afterwards, the policy of banning

the import of these types which could be indigenously manufactured was more strictly enforced. The Indian price-quotations, for the most part, are for the period after 1960. The price-index of US Metal Working Machinery rose from 91.7 in 1956 to 109.0 in 1962 (Base 1957-59 =100) indicating a rise of about 17 per cent.¹ The price-index for Indian machine tools rose by the same percentage during this period, from 84.5 in 1956-57 to 102.9 in 1962-63 (Base 1960-61 =100)². In Western European countries, the price of machine tools since 1960 have remained more or less stationary probably because of the intense competition among the manufacturers of the ECM.³

Some observations may be hazarded even from such a scanty data:

- (i) The prices of medium and heavy types of Indian machine tools are generally higher than those of corresponding foreign items.
- (ii) For simple types, such as bench drill, and bench lathes, the prices of Indian items are competitive with those of corresponding items.

¹United States Department of Labour Bureau of Labour Statistics. Prices: A Chart Book 1953-62, Bulletin No. 1351, U.S. Government Printing Office, Washington, D.C., December, 1962, p. 179

²Government of India Department of Supply, Directorate General of Supplies and Disposals, Index Numbers of Purchase Prices for 1963-64, pp. 28-29.

³S.M. Patil, "Summary of Important Observations" (Mimeo): Bangalore, 1963.

iii) The data for a few items (such as double housing planer, turret, universal milling) indicates that the prices of items from Eastern European countries and USSR may be somewhat less than those of items from U.S.A and Western European countries.⁴

The dealers with whom the author had discussions on the subject, asserted that Indian Machine tools were two or perhaps three times costlier than the corresponding foreign items. One suspects this to be an exaggeration. The detailed examination of the comparative price-structure can be made only if thousands of Indian items of various types and sizes are closely matched with corresponding foreign machine tools making adjustments for differences in quality and additional design features. The conclusions from such scanty data as are available cannot very much be depended on.

⁴ Seymour Melman in his "Peace Race" estimates that as of 1961, a dollar available for capital expenditure will buy twice as much Soviet produced machine tools of the same type as the United States produced equipment. This difference is ascribed to the application of mass production methods in USSR as opposed to the batch production method in USA. The Peace Race- Victor Gollarz, London, 1962.

Table S-6
The Comparison of the Prices of Indian Machine Tools with those of Comparable Foreign Makes.

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity, Year	Price
1)	All Geared Heavy Lathe 500 C.H x 1250 mm. Messe & Wiede, West Germany 1956	12,829	1)a.	All Geared Head Heavy Lathe 500 C.H x 1500 mm. Batala Engg. Co., Batala 1965	15,850
			b.	LK All Geared Head Lathe 200 x 1500 Mysore Kirloskar-Harihar 1964	19,375
2)	Cone Pulley Lathe 1250 mm Southbend, U.S.A 1956	13,000	2)	Cone-Pulley Lathe 1250 mm Batala Engg. Batala 1965	11,900
3)	<u>Bandsaw</u> Wells No. 8 Bandsaw 6" Round Section (Max) Wells U.S.A 1956	7,000	3)	<u>Bandsaw</u> 6" Round Section(max) Crescent Iron and Steel Co., Bombay 1963	5,317
4)	Blue Point Pedestal Grinder Double ended 10" dia 4" Bore Meteor Swiss and USA 1956	2,000	4)a.	NEI (Natural Electrical Industries) Pedestal Grinder, Double Ended 10" dia Wheel 4" Bore Natural Electrical Industries, Bombay 1965	1,760
			b.	Ashok Double ended Pedestal Grinder 12" dia 4" Bore Ashok Bros. 1965	2,200

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity Year	Price
5)a.	Omerod Slotting MIG 8" x 14" (200 mm x 350 mm) Approx. Omerod, U.K. U.K. 1956	22,000	5)	Cooper-HOV Slotters 250 x 500 mm Cooper Engg. Poona	38,000
b.	HOV. Slotting MIG (approx) Equivalent capacity 250 x 500 mm HOV Czech 1959	20,000			
6)	HOV Slotting MIG 400 x 800 HOV Czech	50,000	6)	Cooper-HOV Slotting MIG 400 x 800 mm 1965	71,000
7)	Strigon Shaper with Hydraulic Copying attachment (approx) 14" Stroke Length Esstergon, Hungary 1961	15,000	7)	Cooper Shaper 24" strokes length Cooper Engineering, Poona 1964	28,994
8)	Module Shaper 24" Strokes length 1962 VEB Module East Germany (approx) 1969	10,000	8)	Cooper Shaper 24" Strokes Cooper Engineering, Poona 1965	30,000

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl. No.	Machine, Manufacturer, Capacity, Year	Price
9)a.i	Tos Double Housing Planer 1250 mm x 1250 mm x 3000 mm Capacity x Stroke length Strojexpart Czechoslovakia 1962	(approx) 1,40,000	9)a.	Cooper Loudon Heavy Duty Planning machine 4' x 4' x 10' Cooper Engineering India 1965	4,00,000
	ii. Collaborations Equivalent Model 1959	" 2,20,000			
b. i.	Tos Double Housing Planer Strojexpart-Czechoslovakia 1250 x 4000 1962	" 1,60,000	b.	Cooper-London Heavy Duty Planer 5' x 5' x 12' Cooper Engineering India 1965	4,94,850
	ii. Wadrich Coburg Double Column Planer 1260 x 1250 x 4000 Wadrich Coburg, West Germany 1964	" 2,00,000			
	iii. Collaborator's (London) Equivalent Model 1959 London	" 3,00,000			

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity, Year	Price
10)	Schneider Surface grinder 250 x 500 Schneider, West Germany 1955	(approx) 16,000	10)	Harig Surface Grinder 250 x 610 Harig Mig. Co. Sahibad Punjab (India) 1965	37,875
11)	Richmond Bench Drill 1/2" dia Richmond, U.K. 1956	" 1,500	11)a.	Praga Bench Drill 1/2" dia Praga Tools Co. Ltd. 1964	1,529
			b.	Investa Bench Drill 1/2" dia Investa Mhs. Tools Engg. 1964	1,200
			c.	Sagar Bench Drill 1/2" dia Sagar Co., India 1959	700
			d.	Sonalkar Bench Drill 1/2" dia Sonalkar Engg. Harihar 1964	950
12)	Archdall Pillar Drill 50 mm Archdall U.K. 1959	" 8,000	12)	Investa Pillar Drill 50 mm Investa Machine Tools India 1968	7,123

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity Year	Price
13)	Churchill Redman Centre Lathe Approximately Equivalent capacity Churchill-Redman U.K. 1955	(Approx) 12,000	13)a.	Investa Centre Lathe 165 x 800 mm Investa Machine Tools 1963	10,000
			b.	<i>Harika</i> Marshan No.1 Centre Lathe 165 x 1370 mm Mysore Kirloskar 1964	5,557
14)	Carroll and Jamieson Centre Lathe 9" x 8" Batavia, U.S.A 1956	10,000	14)	Shimoga No.2 9½" x 8-10" Mysore Kirloskar 1964	11,122
15)	'V' Bench Lathe 4" x 16" Logan, U.S.A 1956	4,000	15)	Bench Lathe 250" Swing Punjab Manufacturing 1965	3,000
16)	Collaborators' Comparable Model (approx) 15,000 Joshua Heap & Co., U.K.		16)	NSE-Heap's Universal Screwing Machine 1"-6" For Pipes 1"-3" For Bolts New Standard Engineering 1966	12,690

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity, Year	Price
17)	Collaborator's Comparable Model (approx) 1,00,000		17)	Cooper-Schiers ^s Vertical Turret Lathe Model. 12 EK 85 with one cross rail head with five tool turret and one side lead with square turret on the column Cooper Engineering-Poona 1965	1,99,980
18)	Collaborator's comparable Model (approx) 1,50,000		18)	Cooper-Schiers ^k Vertical Turret Lathe Model 13 EK 125 with one cross rail head with five tool turret with one side head with square turret on the column	2,53,860
19)1.	Herbert No.4 Capstan Lathe 1½" dia Alfred Herbert U.K. 1956	" 20,000	19)	Herbert Kirloskar No.4 Capstain Lathe 1½" dia	32,049
2.	Ward No. 3 A Capstan Lathe 1½" dia Ward, U.K. 1955	" 30,000			

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity, Year	Price
20)a.	Herbert No. 7 Turret comparable & Model Albert Herbert U.K. 1963	(approx) 35,000	20)a.	Herbert Kirloskar Combination Turret Lathes Upto 225 mm Hindustan Machine Tools 1964	42,141
b.	Ward No. 7 Turret Comparable Model Ward U.K. 1963	30,000	b.	Hindustan L-TP turret upto 225 mm Hindustan Machine Tools 1964	44,000
c.	HCP Polish Turret Comparable Model	25,000			
21)a.	Cincinnati No. 5 Horizontal Milling 300 x 1250 Cincinnati U.S.A. 1958	30,000	21)	Hindustan Horizontal Milling 310 x 1100 Hindustan Machine Tools 1964	40,000
21)b.	Milwaukee Horizontal Milling Comparable Model Milwaukee U.S.A. 1962	35,000			

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity Year	Price	Sl No.	Machins, Manufacturer, Capacity Year	Price
22)	Tos Horizontal Milling 425 x 2000 Strojexport, Czech 1960	(approx) 38,000	22)	Hindustan Horizontal Milling 360 x 1600 Hindustan Machine Tools 1964	44,000
23)a.	Herbert Vertical Milling 250 x 1250 Herbert U.K. 1948	" 20,000			
b.	Cicinati vertical milling 300 x 1250	" 30,000			
c.	Archdale Vertical Milling 350 x 1500 Archdale U.K. 1950	" 25,000			
d.	TOS Vertical Milling 425 x 2000 Strojexport. Czech 1960	" 40,000			

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity Year	Price	Sl No.	Machine, Manufacturer, Capacity Year	Price
24)a.	TOS Universal Milling Comparable Model Strojexport -Czech 1961	(approx) 35,000	24)	Hindustan M.V. Horizontal Milling 275 x 1100 mm Hindustan Machine Tools 1963	45,000
b.	Universal Milling Comparable Model Metal-Export- Poland 1962	" 32,000			
c.	Kemp-Smith Universal Milling 300 x 1250 Kemp-Smith, U.S.A. 1960	" 40,000			
25)a.	Jig. Boring Machine 750 x 1100 mm. MMW. East Germany 1961	" 1,20,000	25)	NIL	
b.	DeVlieg Jig Mill 800 x 1200 DeVlieg U.S.A. 1963	" 2,00,000			

FOREIGN			INDIA		
Sl No.	Machine, Manufacturer, Capacity, Year	Price	Sl No.	Machine, Manufacturer, Capacity, Year	Price
26)a.	Richmond Radial Drill 1½" x 3' Richmond U.K. 1956	15,000	26)a.	Hindustan Radial Drill 40 x 925 mm Hindustan Machine Tools 1962	38,000
b.	Polish Radial Drill (approx) 1" Metal-export Poland 1962	9,000	b.	Investa Radial Drill 30 x 965 mm Investa Machine Tools 1963	14,000
27)a.	WMW Horizontal Boring " 80 mm WMW East Germany 1962	1,00,000	27)	Nil	
b.	VDF Deep Hole Horizontal Boring 82 x 1500 mm VDF West Germany (approx) 1963	2,00,000			
c.	Oerlikon Horizontal Boring " Comparable Model Oerlikon, Swiss 1963	1,50,000			