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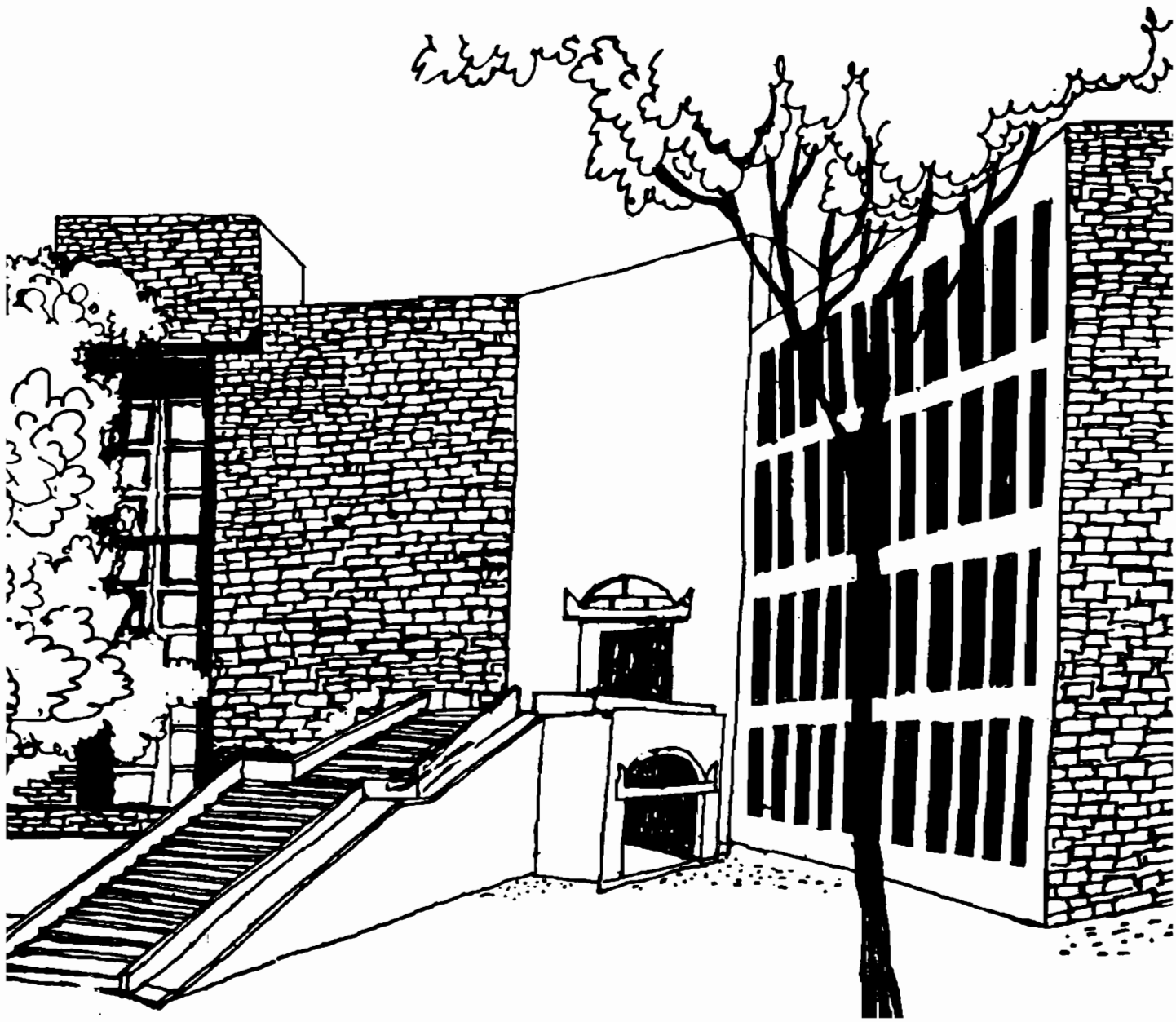

Indian Machine Tool Industry: Caught at the Cross Roads

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Indian Machine Tools Industry
-Caught at the cross roads

1. Introduction

The machine tools industry is one of the oldest in India. In the preindependence period, there were small and medium scale units manufacturing simple lathes and drilling machines in the private sector. A firm in Calcutta was the first one to start organized manufacture of machine tools in 1930. Two leading manufacturers, namely, Cooper Engineering(1937) and Kirloskar Brothers Ltd.(1938) set up their units later. The second world war increased the demand for machine tools and encouraged the entry of more manufacturers in the industry. In 1951, the first year of the first five year plan of India, there were 14 companies in the large and medium sector. Most of them were making simple machine tools. The total value of sales was around Rs.3 million. Nearly 80% of the country's requirement was imported.

Today the industry produces a wide range of general and special purpose machine tools and accessories in the small, medium and large public and private sector units. There are about 160 machine tools manufacturing units in the large and medium sectors and 300 units in the small scale sector. They have displayed their products in national and international exhibitions. They have even transferred their technologies to other developing countries and exported their products to developing and developed countries. The wide range of machine tools produced by Indian companies can be seen from Exhibit 1.

1.1 This Report

In this report we present an overview of the industry and the findings of the field and mail surveys. We have had indepth discussions in 19 companies in the industry. At the time of writing the report, industry firm questionnaires relating to 14 companies were complete in most respects. The response to the mail survey was not very encouraging. Out of 100 companies, only 10 responded. We had discussions with four TIs associated with the industry and the questionnaire information could be collected for only three TIs. Further insights were obtained from discussion with the officials of Indian Machine Tools Association. The field and mail survey insights have been strengthened by secondary sources of information like company annual reports, brochures, bulletins of the industry association and articles in academic journals, and business dailies and magazines.

We had discussions with four TIs located in various parts of the country.

Table 1.1

Distribution of Employee strength of mail survey respondents

Employment Category	No. of Respondents
< 50	1
51 - 100	2
101 - 300	5
1001 - 3000	1
> 5000	1

1.2 An Idea of the Sample

1.2.1 Mail survey sample

The mail survey respondents were primarily from medium sized companies with employment between 101 and 300. There was a company employing less than 50 persons. There was also a company employing more than 5000 persons.

Nine out of the 10 companies were in the private sector. Among these 6 were private domestic companies. The nature of ownership of mail survey sample (MSS) companies can be seen from table 1.2.

Out of the 10 companies 7 companies were started by people with engineering background, 2 by those with entrepreneurial background. Only 2 companies had not grown rapidly. 4 respondents had grown rapidly in the past. But one of the respondents had grown phenomenally. Details and growth experience can be seen from table 1.3.

Table 1.2

Ownership of mail survey sample companies

Ownership	No. of companies
Private domestic ownership	6
Private foreign company	3
Others	1

Table 1.3

Growth experience of the mail survey respondents

Sales growth	No. of respondents
Negligible	2
Moderate	3
Rapid	4
Phenomenal	1

1.2.2 Field survey sample

We conducted indepth interviews in 19 machine tool companies. At the time of preparing the draft report, we had complete questionnaire information on 14 companies. In this section, we present the findings from the data collected from 14 companies.

We had 6 small , 5 medium and 3 large company situations in the sample of 14. Among the five remaining companies where interviews were also held, we had four medium and one large company situations. 9 out of the 14 companies were more than 25 year old. Only one company was less than ten year old. The remaining 4 were between ten to 25 years old. Out of the 14 companies, 5 were from family owned enterprises and 2 were public sector undertaking. One was a public limited company. Eight out of the 11 companies that provided information on sales had experienced above average growth rates. in the last five years. The spread of growth rate can be seen from table 1.4.

Table 1.4

Growth experience of field sample companies

Rate	Sales growth (No. of firms)	1987-92 (Percentage)
Declining	0	0
Negligible	3	21.43
Moderate	3	21.43
Rapid	6	42.86
Phenomenal	2	14.28

Thus, we have the experience of twenty nine companies together to draw on.

2. Role of the Government in Building the Industry

Impetus to the growth of the industry into a multi product and multi technology industry was given by the Government of India in the post-Independence period. Augmenting the nation's capabilities in building machine tools was considered, by the national planners, as a prerequisite for accelerated industrialization of the country. The machine tools industry was recognized by the Government of India as the mother industry that created other industries. The Government of India has played three distinct roles in building the industry. As a policy maker it developed a package of protectionist policies to create a manufacturing base in the country. Later it liberalized the industry to instil competition in the industry. With a view to encourage the growth of small scale industry certain concession in terms of excise duty reliefs and concessional loans were given. Certain products were reserved for the small sector.

As an institution builder it has set up research and educational institutions in the country to supply technically trained manpower to the industry. As an entrepreneur it has set up manufacturing unit in the public sector to hasten the creation of capacity in the industry and augment the same.

The following paragraphs provide the details of these roles.

2.1 Key Policies

As pointed out earlier we can see two distinct phases in the development of policies for the machine tool industry. The first phase was guided by the objective of protecting the industry and building certain manufacturing and technical capabilities. The second phase which is till running is guided by the need to build the "competitive capabilities" of the industry.

2.1.1 The years of protection

To encourage the development of indigenous machine tools industry, the Government of India provided protection to it by shielding it from direct competition with international players. It imposed high customs duties and made imports expensive. The imports of those varieties that were produced indigenously were banned. Technical collaboration with foreign parties was allowed after evaluating the collaboration agreement. Mere CKD and SKD types of operations were discouraged and the companies had to have a phased manufacturing programme along with the collaboration agreement. The recipient of the collaboration also had to agree to a programme of indigenization and ancillary development. The Government also regulated the payment of royalties. Financial joint ventures were allowed on a very selective basis. The Indian partner in such ventures had to have a majority status.

The protectionist policies created opportunities for import substitution and indigenization.

The government even regulated competition within the domestic industry by subjecting it to licencing, registration with DGTD, MRTP and FERA restrictions. Separate licences were required to produce different products. Significant expansion plans also had to be approved by the Government of India.

Above policy measures created a highly diversified industry. The extent of spread of the product range has been shown earlier in exhibit 1. However, the absence of competition led to a high cost machine tool industry. The costs were not comparable to the landed price of the imported machine tools. The scales of operations were too small compared to the comparable international operators. The learning from one type of machine tool manufacturing could not be transferred easily to produce other types of machine tools. Nor were there significant technological innovations in the industry. The Government of India decided to change the policy in favour of greater domestic and international competition.

2.1.2 The years of liberalization

In the recent past the policy scenario has changed in favour of less protection and more competition. Liberalization process started in the early seventies itself with the Government allowing companies to expand their capacity automatically by 25% in five years. This was followed by the broad-banding policy where separate licences were not required for producing different types of machine tools. The last measure has been the delicencing of the industry and allowing new domestic and foreign companies to enter the industry. The Foreign companies can have controlling interest. The import policy has been liberalized. Duties have been reduced by 50% and imports have been permitted through open general licence rather than through a canalizing agency of the government. Even the import of second hand machine tools has been allowed.

2.1.3 Policy support to the small scale sector

As noted earlier Concessions in taxes and duties were given to the small scale sector. The Government of India did not have any specific policy for small scale units in the machine tool industry. However, all the incentives available for the small scale units are also available for the units in machine tools. As a part of policy of reserving certain products for the small scale sector the government announced a list of products for the small scale sector. Exhibit 2 provides the list of products reserved for the small scale industry.

2.2 Institution Building

2.2.1 Educational and research institutions

The Government of India set up national technological institutions in five different parts of the country to train young men and women in various disciplines of science and engineering and carry out research. These institutions offer undergraduate, graduate and doctoral programmes in technology. Each of these institutes has a mechanical engineering department that trains students and researchers in design and testing of machine tools. They also undertake research and consultancy to help the industry. Another model of institution building was tried with the setting up of Central Mechanical Engineering Research Institute set up in 1958 to support a wide spread research in mechanical engineering. This institute set up a separate machine tools division to promote research in machine tool design and operations. This institute set up its offices in various parts of the country to help the industry. This institute has contributed to the development of new design and testing of machine tools in India. Yet another initiative by the Government of India was the creation of an industry focused research institute called Central Machine Tool Institute (CMTI) in 1965 in Bangalore in collaboration with Czechoslovakian Government. This institute developed facilities for design and testing of machine tools and contributed to the development of several new designs of machine tools, especially in the area of numerically controlled and computerized numerically controlled machines.

Setting up these institutes not only provided technically trained engineers but also researchers to the industry. Details of the contribution of these institutions would be presented later.

2.2.2 Institutions for the small scale sector

The National Small Industries Corporation was set up under the Ministry of Industry in 1955 to promote and foster the growth of small industries in the country. It was set up to create wide ranging services from technology transfer to hire purchase for the benefit of the small scale industries. NSIC has set up under its aegis 5 prototype development and training centres and 4 sub-centres to provide

technical training and technology related services to the small scale industries in various parts of the country.

The objective of the 5 PDTCs are similar. They have been set up as multi-purpose institutions aimed at imparting class-room training and practical demonstration in several industrial trades. They are also required to develop specialized training programmes for rural artisans. To help them organize their training centre activities, they have been provided with facilities like testing, machining, casting, electroplating and extension. The centres are also expected to develop prototypes of machines, equipments and tools and pass them on to manufacturing units for commercial production. The centres provide common facilities like testing, machining, casting, electroplating in addition to specializing in certain segments of the industry. Two of the five PDTCs are associated with the machine tool industry. Both the centres received foreign support. An idea of activity focus of PDTCs can be had from exhibit..

These centres try to bring in the latest technology relevant for the small scale sector and demonstrate its utility through training and demonstration programmes. For example, PDTC Rajkot has set up a CNC training centre by installing a CNC training machine.

The working of PDTCs is on the lines of any Central Government organization. The Heads of the departments are appointed by the Government.

Recently PDTCs have been recognized as the centres for research and development by the Department of Science and Technology. This enables them to take up independent research projects and introduce new technologies. In addition to training programmes for technicians and workers, PDTCs offer seminars and workshops. They are linked to national and international agencies for taking up research projects.

Setting up the Small Industries Development Organization (SIDO) under the Ministry of Industry to provide services training, common facility services like processing, testing and tooling, marketing, assistance, etc. to small scale units through a network of Small Industries Service Institutes (SISIs), was another significant step. SIDO has grown to have 24 SISIs, 30 Branch Institutes, 6 Extension Centers, 4 Regional Testing Centers, 4 Production Centers, and 15 Field Testing Stations. The other units that were set up to help the small sector were:

(a) Central Institute of Tool Design (CITD), Hyderabad,
(b) Central Tool Room & Training Centre, Calcutta,
(c) Integrated Training Center, Nilokheri in the state of Haryana,
(d) Central Tool Room, Ludhiana,
(e) National Institute of Small Industry Extension Training (NISIET), Hyderabad,

These organizations provide a wide range of services. For example, CITD caters to the need of small scale industry in the field of tool design, development and manufacturing technology, and training of technical personnel. CTRTC essentially caters to the requirements of the eastern region. It helps SSIs through training, consultancy and design, manufacture of plastic moulds, press tools, jigs, fixtures and precision components.

The contributions of these units have been mixed. Details would be presented in a later section.

2.3 Setting up a Manufacturing Unit

The most significant role of the Government in building the industry has been the establishment of a machine tools manufacturing company in the public sector. The company with name and style Hindustan Machine Tools Ltd. started its operations at Bangalore by manufacturing simple lathes in technical and financial collaboration with a Swiss company in 1953. Later it bought over the financial stakes of the Swiss company and acquired strategic independence to diversify into a wide range of machine tools. It developed a wide spread base for manufacturing a wide range of machine tools through foreign technical collaboration, inhouse R&D and acquisition of manufacturing units from the private sector. It promoted units in the joint sector and helped developing countries to set up training institutions and tool rooms. In addition to the creation of capacity in HMT, the Government also set a heavy machine tools division in another public enterprise called Heavy Engineering Corporation at Ranchi.

In sum the Government of India has played an active role in building the domestic machine tools industry.

2.4 Some Feedback on the Use of Government Policies

From both mail and field surveys we obtained feedback on the use of government policies for encouraging industry. The results are presented in tables 2.1, 2.2 and 2.3.

From the tables we may note that a large majority of the field survey respondents do not use the government incentives. The respondents were ignorant of the incentives. Among the users fiscal and export incentives are the ones which are used, but only export incentives seem to have made a significant impact.

Table 2.1

Perceived impact of Government Policies by field survey respondents

Policies	No. of firms	Mean beneficial
Fiscal incentives	4	3.5
Grants	2	-
Special technology loans	3	4.33
Training	1	-
Government programmes	3	3.00
Standards and testing	2	-
Market protection	2	-
Export incentives	5	3

Table 2.2

Use of Government Incentives

	Used	Not used	Total
Fiscal (tax) Incentives	5	2	7
Grants	2	5	7
Special Technology Loans	2	5	7
Training Incentives	3	4	7
Government Procurement	3	4	7
Standards/Testing/Certification Services	4	3	7
Market Protection for the Firm's Products	2	5	7
Export Incentives	6	1	7
Other (specify)			

Table 2.3

Impact of Govt. Incentives

Impact / Policies	1	2	3	4	5	Total
Fiscal (tax) Incentives	4	-	1	1	1	7
Grants	6	-	-	-	1	7
Special Technology Loans	6	-	-	-	1	7
Training Incentives	5	-	-	1	1	7
Government Procurement	5	-	1	1	-	7
Standards/Testing/Certification Services	5	-	1	-	1	7
Market Protection for the Firm's Products	6	-	1	-	-	7
Export Incentives	2	-	1	3	1	7
Other (specify)						

The mail survey respondents had used fiscal and export incentives. The export incentives were found to be having a better impact.

The mail survey responses confirm the positive roles played by fiscal and export incentives. The other policy measures are unused by a majority of the respondents.

3. Industry Structure and Performance

In response to the policy initiatives and the opportunities created by the overall growth of the economy a large number of machine tool units have come up in the private sector to produce a wide variety of machine tools. The extent of competition has been different for different varieties of machine tools.

Like any capital goods industry the machine tools industry has faced its own ups and downs. This section discusses the details of the industry structure and performance of the industry.

3.1 Industry Structure

As presented before, there are 160 units in the large and medium sector and 300 units in the small scale sector producing a wide variety of machine tools. The medium and large companies contribute 80 per cent of the total output of machine tools. The small scale sector contributes only 20% of the total output.

Of the ten respondents to our mail survey four came from the regions where there was a concentration of machine tools manufacturers.

3.1.1 Small Players

The small companies in the machine tool industry are spread all over the country, but the concentration is in Ludhiana, Jalandhar and Batala in the north, Rajkot in the west, and Shimoga and Coimbatore in the south. The existence of small foundries, and small and medium engineering enterprises in and around the place, has been a major factor for supporting the growth of small units in these regions. The diesel engine manufacturers in Rajkot, for example, provided the initial push for building the base for the development of machine industry. Similarly in the north the metal component manufacturing industry provided the impetus for the growth of the small sector there. In the south it is the pumps and motor manufacturers who provided the initial impetus. The small companies have tended to specialize in one or two types of machine tools. The preference is for making simple and rugged machine tools. Lathes and drilling machines are the preferred types. There are also companies which have moved into the production of milling and grinding machines. The general perception in the industry is that Batala and Jalandhar are known for producing low cost crude machine tools called 'Addas'. Medium quality low cost machine tools are made in Rajkot and Shimoga. Machine tools better than those of Rajkot at medium price are made in Coimbatore.

The competition among the players is very high. The basis of competition is primarily price. The features are similar. The companies have developed their own brand names and sell their products under the brand names. They are sold through agents and dealers. Very few of them have their independent show rooms.

The small scale entrepreneurs have developed the technology for manufacturing machine tools by self study and learning from the experience of similar companies. These efforts have been supported by the workers and supervisors who join these units after gaining experience in large and medium machine tool companies or maintenance experience in engineering enterprises.

The motivations and background of these entrepreneurs have been different.

The following are some of the illustrations of the type of small scale units in the industry.

> A successful small company making drilling machines is contemplating to manufacture key way milling machines. When asked how he would go about getting the technology, he replied, "I have an old Russian machine in my shop floor. I will strip it and copy the design. Of course, I will make appropriate modifications in the design to suit our markets. I will first try it in my shop floor before commercialization. This company was started by his father who had a foundry unit. He built a drilling machine by asking himself as to why he should not make a

machine tool out of the castings he was supplying to machine tool manufactures. He developed one for his own use and made a business out of it later.

Another small company owner, a diploma holder, got into business because he saw the possibility of earning more as an entrepreneur.He acquired the know how while working for a medium sized company making lathes. He decided to make 5 milling machines to avoid direct competition. He used the local facilities available for casting and component making and sold few machines through agents. He established direct contact with the customers to get feed back. The customers showed inclination to milling machines if he developed one. Currently this entrepreneur is studying the design of a popular milling machine.

A cycle repair workshop owner built a lathe for repairing the components by copying a running model through trial and error. A neighbouring industrialist persuaded him to sell the lathe to him. He sold it at a profit and decided to manufacture more machine tools. He has built on his success and emerged as a leading player in the small scale segment of the industry. At the time of our visit he had built a grinding machine for inhouse use. He was contemplating to commercialize it if the trials were successful.

The typical customers for the small industry machine tools are repair workshop owners, and small and medium engineering enterprises.

3.1.2 The Large and Medium Players

There are 160 large and medium players in the industry.

HMT Limited, the public sector undertaking, dominates the industry with nearly 50% of the share in the total production of machine tools. Along with its subsidiaries it accounts for about 35% of the sales of machines. An idea of the shares of the large players can be had from table 3.1.The large companies have a diversified portfolio. They offer a wide range in various families of machine tools. They vary in size, accuracy, speed, multiplicity of functions and control mechanisms. They have their own foundries. They are also supported by a network of ancillaries around them. All of them have capabilities to make special purpose machines. In addition, there are few companies that have focused on special purpose machines only. HMT has adopted the full line strategy of offering almost every variety of machine tools. It presents itself as a one stop shop for machine tools. Building on its success in assimilating the technology and establishing its name in the domestic market, it diversified its range of products to span both metal forming and metal cutting machine tools. It established its units in new locations like Kalamassery, Hyderabad, and Pinjore. The diversification of range was made possible by several technical collaborations obtained from leading manufacturers in Germany, USA, UK and Japan, and internal R&D efforts. It transferred its technologies to a state government unit in Gujarat. It also exported its machine tools to the developed and developing countries. HMT also developed the domestic market for indigenous machine tools through exhibitions and customer education. New small entrepreneurs, attracted by the successful models, offered their own by either reverse engineering the successful products or by modifying the specifications to bring out newer varieties. The existing companies responded to the competition from HMT by developing their own models through their own R&D efforts and entering into collaborations with foreign manufacturers. As HMT recruited fresh engineers in large numbers and trained them in its training centres and at times at the collaborators place, it provided a basis for drawing trained and experienced manpower to build the industry. It interacts closely with CMTI and has set up a Central Metal Forming Institute (CMFI) to support training and research in metal forming machines.

Table 3.1			
Share of Large Companies in the machine tool industry			
Company	Sales (Rs. million)	Market Share (%)	Year ending 1990
HMT Ltd	1781.5	23.8	March
Klockner Windsor	559.4	7.5	Sept
Batliboi & Co	517.0	6.9	June
Mysore Kirloskar	348.1	4.6	June
Premier Automobiles	333.6	4.4	June
Praga Tools	325.2	4.3	March
Voltas	177.7	2.4	March
Source : NPC Research			

The other large players in the industry have their units located in the south and western parts of India. There are companies which have focussed on selected family or families of machine tools. eg. Bharat Fritz Werner have focussed on milling and grinding machines, HMT machine tools, earlier known as Accummax has focussed on drilling machines. Kirloskars have adopted near full line strategy by offering a range of machine tools in turning, milling and grinding families.

3.1.3 Modes of Private sector entry into the industry

The large and medium private sector players have entered the industry with different strategic background and entry facilitators. Some have entered the industry from the background of trading in machine tools. Batlibois, for example, were distributing the machines of small and medium scale units. They went into manufacturing of non competing range of machine tools in technical collaboration with an American company. Thus the entry has been facilitated by the availability of foreign technical collaboration. The second type of entry has been the one with financial and technical collaboration with foreign producers. GD Sons, a business group in Coimbatore entered the machine tools business in financial and technical collaboration with Wiler of Germany to make precision machine tools. Bharat Fritz Werner is another company of this kind. Excello has entered as a subsidiary of a multinational company.

Another entry has been through the acquisition of an ongoing machine tools company. TELCO a commercial vehicles manufacturer entered the machine tools business by acquiring a private machine tools company. Having acquired the business it built it with technical collaboration with foreign companies and its own R&D efforts.

There is also a mode of entry where the company has its own inhouse designs or the ones developed with the help of technical institutions or private sector consultants. Parishudh Sadhan Yantra, a jobshop company entered the industry with the help of designs developed through a technical institution and a consultant.

PSG Industrial Institute, belonging to a trust, produced machine tools with its own designs to meet the requirements of its pumps and motors business. The support for improvements in design was provided

by its sister institution, PSG college of technology. From captive production it branched into commercial production.

The customers for the large medium enterprises have been the small, medium and large enterprises in the major machine tools user industries like automobiles, automobile components, metal working industries making consumer durables and semi durables, ordnance factories and railways.

3.1.4 Competition in the industry

The nature of competition in the industry has differed from machine tool to machine tool. In the lathe varieties for example the competition is intense. Almost all the machine tool manufacturers have a presence in the lathe segment. In the milling, drilling and milling families the competition is oligopolistic. There are some precision machine tools segments where the market is either duopolistic or monopolistic. The large players have managed to have a portfolio where they have a monopolistic advantage in at least one product.

We also got some idea of the market shares and the degree of competition from the surveys.

Five respondents out of ten had an above average share in the domestic market, but not so in the international market. The market shares of the respondents can be seen from the table 3.2.

Table 3.2

Shares of the mail survey respondents in the domestic and international markets

Market -> Market Share	Domestic Market	International Market
1. Minor	1	4
2.	Nil	3
3.	3	-
4.	4	-
5. Dominant	1	-
Missing	1	3

The companies faced intense competition in the domestic and international market. The perception about the degree of competition in domestic and international markets can be seen from Table 3.3.

The shares of the respondents in the domestic markets were different. 6 companies reported insignificant share in the domestic market. Small share was reported by 3 companies and 5 companies felt that their share was important. No one seem to consider himself a monopolist.

Out of the 14 companies, only one company did not have a presence in the export market. 2 companies were exporting to both developed and developing countries. 5 companies exported only to developing countries. 6 companies exported to industrialized countries. The competition in the export market is faced from companies from other countries.

Table 3.3

Perceptions of Competition in the Domestic and International Markets

Degree of competition	Domestic Market	International Market
1. (none)	Nil	1
2.	3	1
3.	3	1
4.	-	2
5. (very high)	4	5

3.1.4.1 Sources of competitiveness

It can be noted from the field survey data that the machine tools companies have consider all several factors as important for gaining competitiveness. This means that the companies have to have several attributes to be competitive. Among the above average factors product quality and reliability occupy the top positions. This is followed by price. Product designs and delivery time are not considered as providing as high a competitive advantage as others. This is perhaps because the designs can be easily copied by others in the industry. Since investment in machine tools is a capital decision the customers do not mind waiting to get reliable and quality products. Hence delivery is considered less important than other factors. Based on the industry response, the sources of competitiveness can be ranked as follows:

Table 3.4

Sources of Competitiveness

Source	Rank	Mean importance
Product reliability	1	4.64
Product Quality	2	4.50
Lower Price	3	4.00
New Product Development	4	3.87
Product Design	5	3.51
Shorter delivery time	6	3.50

3.1.5 The future of competition

In the liberalized context the machine tool industry has the seeds of being highly competitive. New entries are expected from foreign companies in the newer segment of the machine tool industry and the existing captive manufacturers like TELCO might enter the market. In addition the existing

manufacturers would have face competition from imported machine tools. There could be restructuring of the portfolio of the diversified manufacturers like HMT and Kirloskars.

The various modes of entry in the industry have brought in players with different strengths and strategic backgrounds. During the regulated phase of the industry these did not matter much. In the liberalized phase, they could be the bases for developing alternative competitive strategies.

The existing players especially HMT, the dominant player, are required to be more agile and responsive to the changes in the environment. The survival of the domestic players as independent companies depends on the speed with they upgrade the technologies on their own and bring in new products to meet the quality and price competition from imports or new subsidiaries of multinational players. The easier option is to invite the technical collaborators to have a share in the equity and wait for the strategies to be developed jointly. This results in a loss of opportunity to emerge as independent global players.

3.2 Performance of the Industry

3.2.1 Capabilities of the Industry

Over the years the machine tools industry has developed the following capabilities :

Acquire, assimilate and upgrade sophisticated technologies from abroad

Reverse engineer, design, develop, test and productionise a wide range of general and special purpose machines

Develop market for new machine tools by providing support to the customers before and after sales.

Transfer technologies to new units on a town key basis.

Train manpower and offer technical services relating to setting and managing machine tool units in India and abroad.

Design, develop and productionise cutting tools, moulds, jigs and fixtures, and erect and commission tool rooms.

During our field surveys we observed that all the large companies had developed all the capabilities mentioned above. The small and medium companies had the capabilities to reverse engineer the product. In our field work for other sectors, we found that the above capabilities were present not only in the machine tool manufacturing companies but also in the machine tool user companies who built their own machine tools for captive consumption. We often encountered observations like:

> We bought this machine from such and such a machine tools manufacturer. We modified it to suit our needs. We have made more machines of the modified kind at nearly one third the cost.

> We found that the machine tool manufacturers were quoting a very high price for this machine. We decided to design and produce it ourselves. We did it at two third the cost.

For making radiators with thin gauze material we needed a special purpose machine. We developed it our selves. To day it is a source of competitive advantage as we are able to produce the radiators at a very competitive cost.

We could not afford to buy the SPMs we needed. We bought low cost GPMs and made modifications in them to serve the purpose of semi SPMs.

The above capabilities have been built through inhouse efforts and help from consultants, technical institutions and foreign collaborators. This aspect will be elaborated later.

3.2.2 Trends in Production

Like any capital good, the Indian machine tool industry has also witnessed ups and downs in the business cycle. It is the first to be hit in the period of recession and the last to recover when the recovery starts. A major factor responsible for the cycles has been the fluctuating new and replacement investments in the major machine tool user industries like automobiles, railways, defence, industrial machinery and metal products. The first recession in the industry after independence was faced in 1967-68. The last two years, namely 1991 and 1992, were also the recessionary years.

The total production of machine tools in India has increased from Rs. 3 million in 1950 -51 to Rs. 9,215 million in 1991-92. The first exports were in 1961. The exports since then have increased from Rs.1.50 million to Rs.499.54 million in 1992. The imports as a percentage of total consumption have declined from 85% to 35%.

The growth of machine tool production in the last few years can be seen from table . It can be seen from the table that the total production of machine tools has more than doubled in the last six years. The production of type A machine tools,namely, the metal forming and metal cutting machine tools, as a proportion of the total production has centred around 61 per cent. What is noticeable is the increasing share of the CNC machines in the type A machine tools. It has increased from 9 percent to 37.26 per cent. This is expected to increase further.

3.2.3 Exports and imports

Indian machine tools are exported to forty six countries. Initially the share of exports to hard currency areas was higher than that to the rupee trading countries. It is significant to note that while formulating its export strategies in the seventies, HMT desired to get into the toughest markets in the developed countries first. With the change in the mix of demand and emergence of cost competitive suppliers from Japan, Taiwan and South Korea the competitiveness declined. As result the share of exports to the hard currency areas declined. The share of exports to Rupee trading countries Russia and Bulgaria increased to form 80 percent of the total exports. With the collapse of the USSR the markets vanished and the overall exports declined from Rs.1047.15 million in 1991 to Rs.499.54 million in 1992. The Group B exports declined from Rs.598.55 million in 1991 to Rs.263.51 million in 1992. Group A exports declined from Rs.448.60 million and Rs.236.03 million in the corresponding years. In fact the total exports to USSR declined from Rs. 742.30 million in 1991 to Rs. 124.33 million in 1992. The exports of machine tools to USA and Germany also declined, while the exports to Japan increased from Rs. 8.51 million to Rs. 18.58 million. This experience is captured in Tables ....

Of the seven respondents only 2 companies had exported more than 25 per cent of their sales and 4 had exports between 5 and 25 percent of the sales. Only one company had exported less than this.

Table 3.5

Machine Tool Production

(Rs. million)

Year	Production (A & B)	Production (A)	A as % of A and B	Production CNC Mcs	CNC Mcs as % of A
1986	3718	2258	60.73	190	9.00
1987	4172	2454	58.82	479	20.00
1988	4632	2752	59.41	670	24.34
1989	5553	3392	61.08	1050	30.95
1990	6945	4132	59.07	1370	33.16
1991	7732	5042	65.20	1890	37.49
1992	7842	4998	63.73	1860	37.26
5 year average	6550.8	4063.2	62.00	1362	33.52

Source : "Machine Tool Industry in India", IMTMA, Delhi, September 1993.
"Machine Tool Industry in India", NPC Research Division, *Productivity*, April-June 1992, pp.114-140

A Type : Metal cutting and metal forming machine tools

B Type : Welding, Plastic die casting and pneumatic equipment Machine Tools

Group C: Small and cutting tools, testing & measuring instruments.

Table 3.6

Export & Import of Machine Tools (Rs.in Crores)

Year	Total Imports	Total exports	Total output	Total consumption	M/Total consumption	X/Total output
1955	5.20	-	0.68	5.97	89	-
1970	18.3	2.79	37.45	52.69	35	7.44
1980	104.84	20.85	185.95	269.96	39.0	11.2
1981	110.00	23.25	234.22	320.97	34.3	9.9
1982	120.00	24.16	266.51	362.97	33.1	9.1
1983	150.00	25.00	200.00	375.00	40.0	12.5
1984	161.60	20.00	282.27	424.10	38.1	7.2
1985	155.00	30.00	342.00	468.00	33.1	8.8
1986	175.00	46.00	372.00	500.00	35.0	12.4
1987	206.00	70.00	417.00	547.00	37.7	16.8
1988	218.00	46.00	463.00	617.00	35.3	9.9

Source: 1. NPC Research;
2. A Study of Indian Machine Tool Industry - UNIDO-HMT Workshop: 1975
3. IMTMA Bullctin 1993

Table 3.7

Machine Tool Exports and Direction

Year	Total exports (A + B)	% to Rupee Trade countries
1986	46.00	42
1987	69.90	43
1988	46.00	56
1989	79.67 *	57
1990	118.76	68

Source : NPC Research

Table 3.8

Trends in Exports to Leading Countries

(Rs.in million)

Year / Country	1985	1986	1991	1992
U.K.	7.10	7.06	10.30	10.99
U.S.A.	14.77	26.23	34.19	5.47
Germany	10.34	46.68	48.41	21.54
Japan	2.61	3.07	8.51	18.58
USSR	165,66	192.08	742.30 (CIS)	124.33 (CIS)
Total Exports	324.54	533.82	1047.15	499.54

Source: 1. IMTMA Bulletin

With the changes in technology and emergence of more technically cost effective machine tool manufacturers from Taiwan and Korea, the overall competitiveness of the machine tool industry has declined. Earlier, the industry had carved out a place for itself for exporting conventional machines like lathes.

3.2.3.1 Presence in the international markets- field respondents

Out of the 14 companies, only one company did not have a presence in the export market. 2 companies were exporting to both developed and developing countries. 5 companies exported only to developing countries. 6 companies exported to industrialized countries. The competition in the export market is faced from companies from other countries. The competitiveness has decreased over the years. These aspects point to the need for redeveloping the export competitiveness of the machine tool industry.

4. Efforts in Technology Building

The technology of machine tools had remained stable for a long time. The technological improvements were incremental and predictable. The efforts were towards making the machine tool more accurate and fast. Shifts in technology started taking place with the efforts in making the machine tools more automatic and flexible. Application of both computer and laser technologies have changed the shape of machine tool technology. The computerized numerically controlled machine tools are scoring a lead over the conventional machine tools. The cycle time between design and commercialization has been reduced with techniques like simultaneous engineering.

Along with the changes in machine tool technology the manufacturing technology has also changed. The emphasis of the new manufacturing technology is on quality, flexibility, integration with information technology and time. The machine tools are made with flexible machines and robots. This has necessitated the overhauling of the existing facilities by the existing manufacturers. They have to learn and unlearn simultaneously. The new comers here have an advantage.

The Indian machine tools manufacturers have kept pace with the changes with a mix of inhouse effort and acquisition of technology through collaborations.

4.1 Inhouse Efforts

Two organizational mechanisms for inhouse efforts have been identified in our surveys. A separate R&D department is set up to take up assignments in technology development on a continuous basis. The other mode is the setting up of a temporary task force to undertake a specific assignment.

4.1.1 A separate R&D department

Inhouse efforts have taken the route of setting up a permanent R & D to undertake a variety of tasks. Some of the tasks identified by us are designing and producing original machine tools or making modifications in the designs provided by the collaborators to develop higher or lower version of the existing model, developing alternative production and testing methods, developing specifications for new machine tools that could be produced in collaboration with foreign parties, adaptations of collaborators machines to suit local conditions. One of the companies surveyed by us had to redesign the gear box of the collaborator's machines for meeting local needs. This turned out to be a significant innovation and the collaborators asked for reverse transfer of the technology. The existence of an in-house R & D has also helped the companies to develop negotiating capability vis-a-vis collaborators by doing the homework in terms upper and lower limits of affordable costs, training needs, specifications and segments of technology to be bought and followed up in house, taking charge of technology from the stage where the collaborator has left. One of the companies surveyed had faced to extreme situations in foreign collaborations. In one case, which occurred in the beginning of the company's history, the collaborator not only trained the company's people at his place but also took charge of the operations of the plant in India till the technology stabilized. In the other case, which happened in the later part of the company's history, the collaborator sent only the drawings. The company's R & D had to take charge from there.

Another role for the R&D department has been trouble shooting. The problems faced in operations are taken up by the R&D department.

4.1.2 Intensity of R&D effort of the Industry

The department of Science and Technology considers the industry as a low R&D intensive industry. Its investment in R&D is less than 0.2 percent of its sales. It is well below the national average of 1% of the GDP.

The companies surveyed by us had the following profiles of their R&D activities.

The public sector R & D expenditure has centred around 65% of the total R & D expenditure in the industry.

Data from the mail and field survey provides some insights.

The overall R & D expenditure is not very high.

Of the six companies that responded to the question on R&D in the mail survey only one company had spent more than 10 per cent of the sales on R & D. Two had spent less than 1 percent. Three had spent between 2 to 3 per cent. The overall R&D spending has been less than 3 per cent.

Table 4.1

Technological capability distance Between the respondents and the Domestic and International Leaders

Technological leadership	Domestic	International
1. Very low	-	1
2.	-	-
3. Average	1	6
4.	4	3
5. Same as leader	5	-

Table 4.2

Technical expenditure to sales percentages of respondents

Technical expenditure	No. of firms	Percentage
< 1%	5	45.46
2 - 5 %	2	18.18
5 - 10 %	2	18.18
> 10 %	2	18.18
Total	11	100.00

The respondents perceived themselves to be nearer the technological leaders in the domestic market and not in the international market. An idea of the perception of the gap between the respondents and the technological leader can be had from table 4.1.

Six out of the 11 companies had spent more than 1% of the sales on technical Only 2 companies had spent more than 10 per cent of sales on this. The distribution of firms according to sales to technical expenditure percentages is given in table 4.2.

4.1.3 Technical Task forces

The other organizational mechanism has been the setting up of temporary cells or task forces to 'reverse engineer' the imported or popular domestic machines. More than once the request for reverse engineering has come from the customers who have imported machines. Having found importing to

be too expensive he asks his own technical team or a machine tools manufacturer to reverse engineer the machine and supply more machines at a lower cost.

The small companies have done reverse engineering of popular models of large companies and have been able to offer them at a lower price.

The products for reverse engineering have been identified by going through the catalogues of leading international machine tool manufacturers and visiting national and international and international exhibitions.

This exercise in reverse engineering helps the companies to develop capabilities in understanding machines, developing drawings from parts, integration and testing. Companies can produce original machines by building on these capabilities.

One of the medium sized machine tool companies surveyed by us offered a new variety of machine tool for the first time in India by reverse engineering a difficult machine. It built on its strengths and developed a machine for exports.

4.1.4 Characteristics of inhouse efforts

From our discussion with the executives in the machine tool industry we gathered the impression that the Indian machine tool companies have exhibited a low risk taking ability in terms of taking large technological risks. The inhouse efforts have been in favour of building on proven products and technologies. Product and technology changes have been with in a "confidence interval". For example we did not come across examples where a company doubled its scale of production to reap larger economies of scale. We were told however that countries like Taiwan have developed capabilities to mass manufacture machine tools. Nor did we come across cases where companies made dramatic changes in the methods of manufacture.

Our discussion pointed towards absence of integrated learning from collaborations. Multiple collaborations had brought in multiple manufacturing methods. The companies tended to organize production facilities collaboration wise and not function wise. This constrained the process of cross learning and cross fertilization of ideas.

The need to be a pioneer or develop one's own quality specifications and excel is lacking. Hence, the companies are content with reverse engineering or collaborations. Most of the companies are very proud to say that they have mastered the most difficult technologies provided by the collaborator. Some have even offered improvements to the collaborator's design and sold the design back to the collaborators. But, they have yet to develop aspirations of competing and winning locally. Today, the position of the industry is not even among the top 20 companies. It is 21st. Taiwan, China and Korea have risen higher than us.

Given the strategy of moving within a 'confidence interval' the industry could not produce an indigenous response to the shift in the customer requirement from conventional machines to computerized numerical control machines. Numerous collaboration agreement s have been signed by various companies in the industry to obtain the technology. Even those who developed their own CNC versions found the technological gap between the international manufacturers and themselves too big and decided to go for collaboration.

4.2 Foreign Collaborations

The second support has been foreign collaborations. Invariably, the Indian machine tool industry has looked outside for technological collaboration. The type of collaboration has ranged from full fledged technology transfer involving training and initial operations of the plants by the collaborator to transfer of designs and drawings only. They have however been quick to assimilate the transferred technology and indigenise production through inhouse efforts. The countries offering collaborations have been USA, Germany, Switzerland, Sweden, Italy, France, Czechoslovakia, and Japan. Maximum number of collaborations have been obtained from Germany.

An analysis of the trends in the foreign collaborations in the industry shows the following. Table provides the details. It can be sen that in the initial years, large number of collaborations were signed. This declined as the industry stabilized. Changes in technology of machinetools and the development of CNC machines made the Indian companies to look again for collaboration. This was facilitated by the liberalization policies that allowed collaborations easily. The number of collaboration increased again in the eighties. It declined again in the nineties.

The development of numerically controlled machines was a major challenge for the Indian companies. HMT brought out its NC version in 1979. This was preceded by own R&D and active interaction with TI. The pace of change became faster with the introduction of computer integration. The industry could not keep pace with the change and opted for foreign collaboration rather than inhouse development. Even among the indigenous developments there is an imported component of systems and controls.

Table 4.3

No. of Foreign Collaborations in the Machine Tool Industry

Year	Number
1970	6
1975	12
1980	26
1981	22
1982	29
1983	44
1984	34
1985	32
1986	13
1987	10
1988	21
1989	09
1990	24
1991	16
1992	09

Source: 1. NPC Research
2. IMTMA Bulletin 1993

Companies entered into several collaborations with leading machine tool manufacturers abroad to obtain the CNC know-how. This was supplemented in few cases with inhouse efforts and consultations with CMTI. The study of collaborations of 28 machine tool manufacturers reveal the following:

The collaborations have spanned a wide range of products from simple CNC lathes to flexible machining centres. Germany are the prime sources of technological collaborations.

An idea of the sourcewise collaborations can be had from Table 4.3A. It can be seen from the Table 4.3A that as many as 16 collaborations have been with companies in Germany, followed by 7 with Japanese companies. In terms of products, more than 2 collaborations have been signed for CNC lathes, CNC systems, CNC lathe and turnmill centre and machinery centre. The government has also allowed import of CNC machine tools.

4.3 Support from Technical Institutions

The technical institutions are a third source for building technology. The technical institutional environment of the Indian machine tool industry is characterized by the existence of several engineering colleges spread across the country, each having a mechanical engineering department, Indian Institutes of Technology having their B.Tech and M.Tech programme in mechanical engineering, some specializing in machine tools, regional engineering colleges, and research institutions, CMTI, Central Mechanical Engineering Research Institute, Prototype Development and Training Centres (PDTCs),and technical training foundations.

Table 4.3A

Sources of Collaboration for CNC Technology

Country	No. of collaborations
Austria	1
Czechoslovakia	2
France	2
Germany	16
Italy	2
Japan	7
Switzerland	2
Sweden	1
U K	3
USA	4

Source : Compiled from IMTMA Bulletin - 1993

As noted already, the Central Machine Tool Institute(CMTI) was started in 1965 by the Government of India with the assistance from Czechoslovakia. The engineers of CMTI were trained at TECHNO in Czechoslovakia. Initially the overall control was with the government and HMT Ltd. The head of CMTI invariably came of HMT. Over the years this has changed and CMTI has involved more members from the industry and become more market oriented. CMTI has built facilities for design, calibration and testing, prototyping and information services. CMTI was involved in a national census of machine tools. This has created useful information for the manufacturers. The Nettur Technical Training Foundation (NTTF) provides support in tool and die making. It also offers training in these trades.

Our study shows that TIs have been used more for training, mandatory testing, and use of equipments and facilities which the firm cannot import but the TI can. The dependence on the TIs for technology development or evaluation is less. There is a feeling that learning process should be a two-way process. The TIs can also learn from the industry. The large companies feel that TIs are either too academic or too lethargic. They also feel that TIs lack the business orientation and hence cannot deliver on time. Some of these comments would be elaborated later.

In our field study we came across three interesting experiences where companies in the private sector had benefitted from regular interactions with TIs in designing and developing their products.

> A precision machine tool manufacturing unit in the North was started by an ex employee of a TI and an owner manager as a job shop. The two of them thought of getting into the manufacturing of machine tools. They surveyed the successful international products and identified precision internal grinders as a potential product. They decided to take the help of a TI in designing the machine. Being an ex TI man one of the partners was aware of the designing capabilities of the TI. Simultaneously they hired the services of a private designer who was also an ex TI man to design a lower precision machine. Once the designs were ready the prototypes were tested at the TI. Based on the test results and recommendations of the TI the commercial versions were brought out. Both the models were successful in the market. When the

partners decided to develop the CNC versions of the models they went to TI again. They continue to have close interactions with this TI.

Another company was started by three technocrats from a TI. Initially they offered design consultancy to engineering enterprises. When they decided to venture into manufacturing they zeroed in auto lathes. The testing services of TI were utilized by the company. The product is not only a domestic success but also an export success. They entered the export market through reference from a customer. The customer a bearings ring manufacturer bought the autolathes of the company. Seeing the accuracy in performance he recommended the lathes to his collaborator, who is now a regular buyer of the lathes. With a view to develop the export market further the company has set up an office in New York. When the company decided to enter into the CNC sector it turned to the TI again. Acknowledging the contribution of the TI to the company's Growth the company released the following ad in the Silver Jubilee commemorative volume of the TI.

"Thank you (TI). But for you we would not have been what we are today. ...We have proudly maintained the highest of your standards and thus met the exacting international requirements."[1]

In both the cases we may note that the founders had an association with TI prior to starting the business.

The third has grown on the strength of indigenous technology alone. 60 per cent of its sales are from products designed and patented by the company. The remaining contribution is from reverse engineered products. This company has depended on four TIs to supplementing its efforts in design and development. Two of the TIs are located close to the company.

One of the companies obtained the initial support for developing the new product from the TI and supplemented it with its own efforts.

Recently CMTI has been renamed as Central Manufacturing Technology Institute. The institute was involved in the setting up of Metal Working Research Institute in Iran. In 1992 it had an employee strength of 463. Of them 124 were managers with technical background. Government grants continue to be the prime source of revenue. This is followed by short term technical consultancy services to the industry. Contracts with Government bodies did not figure in as an important source of revenue. According to the institute information services, seminars and manufacturing of products are the most extensively used services. It interacts with clients advisory committees and seminar. Tables 4.4 and 4.5 provide information on extent of use of services as seen by the institute and institution client interface.

1 (TI) Silver Jubilee commemorative volume

Table 4.4

Institution-Client Interface

Mechanisms	Importance	
	More Important	Most Important
a. Advisory Committees		*
b. Board of Directors		*
c. Needs Assessment Studies	*	
d. Extension/Outreach services	*	
e. Demonstration Projects		*
f. Special in-house projects		*
g. Organizational Linkages (e.g. memo of agreements or multi-client services)	*	
h. Seminars/workshops		*
i. Other (specify)		*

Source: TI questionnaire

Table 4.5

Extent of Use of Services: Data from TI

Service	Extent of Use	
	Average	Extensively used
a. Information services/software and database facilities		*
b. Trouble-shooting/problem-solving/ consultancy, etc.	*	
c. Testing to Standards, quality, certification, facility and equipment rental, use of pilot plant facilities	*	
d. Training-seminars on technical/ organizational matters	*	
e. Contract R & D, design and prototyping, new product development		*
f. Strategic research without immediate industrial application	*	
g. Manufacturing of products		*
h. Commercial advice including management and marketing	*	

4.4 Private consultants

This is another source for building technology. There are few consultants in India in machine tool industry. Only 5 companies used private consultants and found their contribution above to be above average and the three companies that used individual consultants also found their contribution to be above average.

4.5 Sources of Support for Product and Process Changes

4.5.1 Significant Product and Process Changes

An analysis of the significant product and process changes introduced by the organizations and the support received from various sources shows that respondents have tended to rely primarily on their own efforts.

The data indicates that the companies have tended to rely primarily on their own efforts in bringing about significant product and process changes. It can be seen from table 4.6.

Table 4.6

Sources of Support for Significant Product and Process Changes

Source of Support	Significant product changes	Significant process changes	Total
Own efforts	7	11	18
Collaborators efforts	4	Nil	4
TI efforts	7	5	12
Both TI and Collaborator	1	-	1
Total	19	16	35

Of the 35 significant product or process changes introduced by the respondents TI were involved in 12 situations. The collaborators were involved only in significant product changes, that too in only four cases. both TI and the collaborator were involved in only one case. All the fourteen respondents had introduced significant changes in their products and processes.

The share of TIs is equally divided in bringing about significant product changes. But the companies have relied on themselves for introducing process changes.

4.5.2 Incremental Product and Process changes

When it comes to bringing about incremental process changes even the TIs are not involved in any significant manner. Out of the 20 changes reported by the 14 respondents only 3 changes were introduced with the help of TIs. Table 4.7 gives the details.

The data confirms our observations about the capabilities of the machine tools industry.

Table 4.7			
Source of Support for Incremental Product and Process Changes			
Source of Support	Incremental product changes	Incremental process changes	Total
Inhouse effort	11	8	17
TIs effort	1	2	3
Total	12	10	20

All the firms in the sample survey said that there was no involvement of TIs in organizing interfirm linkages for major and minor on product and process changes. Only 2 firms indicated involvement of TIs in major product and process changes on a long term contract basis and the contribution of the TIs was seen to be average. Similarly, only two firms had long term linkages with other firms for major product changes and the contribution of this link was rated to be very high.

5. Use of Technical Services

This section presents an analysis of technical services by the respondents.

5.1 Field survey findings

The field survey companies used the various technical services less frequently. The usage of services is given in table 5.1.

Table 5.1	
Frequency of Use of Technical Services by field survey sample	
Service	Mean frequency of usage
Information	2.21
Problem solving	1.00
Standards and testing	2.07
Education and training	1.79
Applied R & D	1.29
Strategic R & D	1.00
Engineering Services	1.23
Manufacturing products	1.00
Commercial advise	1.00

Companies have tended to put in their own efforts in training and rely less on outside sources. Training programmes conducted by industry associations, suppliers, joint venture partners and universities were found to be making a greater contribution than vocational institutions. The maximum number of users of a service is 6 out of 14 respondents. The sources have been ranked on the basis of mean contribution. An idea of the usage of these institutions and their contribution can be seen from table 5.2.

Table 5.2

Sources of Support for Training

Sources of training	Rank	No. of firms using the services	Mean contribution
Suppliers	1	3	4.33
Industry associations	2	5	4.0
Universities	3	6	3.67
Joint venture partners	4	3	3.67
Vocational institutions	5	3	3.0
Buyers	6	2	-

Three companies using the suppliers as the source of training have rated their contribution to be the highest.

In the machine tools industry the suppliers of equipments play a significant role in training the employees. Consider the following comment by a drilling machine manufacturer:

- I have been benefitted by my supplier. He not only sells his equipment but also provide training.
- The contribution of the universities and joint venture partners is above average.

The above table also shows that the usage of the sources is not high. Only six companies reported to have used at least one source. The universities and industry associations are used by more respondents than other sources.

5.2 Mail survey findings

The use of TIs services as seen by the respondents to our mail survey was very low. Details can be seen from tables 5.3 and 5.4. The sources of technical services are in table 5.5. The benefits from various services and the problems faced are given in tables 5.6 and 5.7 respectively.

Half the respondents do not use the services of any institution.

Standards and testing, and education and training are the more used services.

Table 5.3

Usage of Technical Services by Mail Survey respondents

Service	Usage---->	Used	Not used	Total
(i)	Information Services	4	6	10
(ii)	Problem Solving/Trouble Shooting	4	6	10
(iii)	Standards/Testing etc.	7	3	10
(iv)	Education/Training	7	3	10
(v)	Contract R & D	2	8	10
(vi)	Collaborative R & D	4	6	10
(vii)	Commercial/Managerial Advice	6	4	10
(viii)	Meeting and exchanging views with technical personnel from other companies (Facilitating Formation of Technical Networks)	4	6	10
(ix)	Other (specify)			

Table 5.4

Importance of various services, as seen by mail survey respondents

Service	Importance	1	2	3	4	5	Total
(i)	Information Services	6		2	1	1	10
(ii)	Problem Solving/Trouble Shooting	6		1	2	1	
(iii)	Standards/Testing etc.	3		1	3	3	
(iv)	Education/Training	3	1	1	4	1	
(v)	Contract R & D	8			2		
(vi)	Collaborative R & D	6		2	2		
(vii)	Commercial/Managerial Advice	4		2	3	1	
(viii)	Meeting and exchanging views with technical personnel from other companies (Facilitating Formation of Technical Networks)	6	1		2	1	

Table 5.5

Sources of Technical Services

Sources-> / Service	Private contract laboratories	Customers with long-term relationships	Suppliers with long-term relationships	Departments/Labs within your firm	Foreign investors and licensors	National technical institutions	Local/regional technical institutions	Consulting firms	Universities and Technical Colleges	Industrial Associations	Academic Associations	Research Associations	Total
(i) Information Services	-	1	1	-	-	1	1	1	-	1	-	-	6
(ii) Problem Solving/Trouble Shooting	-	1	-	2	2	1	1	1	-	-	-	-	8
(iii) Standards/Testing etc.	2	4	1	2	1	2	1	-	-	-	-	1	14
(iv) Education/Training	-	-	1	1	2	1	1	-	2	2	1	1	12
(v) Contract R & D	1	-	-	-	1	-	-	-	-	-	-	1	3
(vi) Collaborative R & D	-	-	-		1	1	-	-	1	1	-	1	5
(vii) Commercial/Managerial Advice	-	-	1	1	-	-	-	-	-	-	-	-	2
(viii)Mandating and exchanging views with technical personnel from other companies (Facilitating Formation of Technical Networks)	-	1	1		1	-	-	-	-	1	-	-	4
(ix) Total	3	7	5	6	8	6	4	2	3	5	1	4	

Table 5.6
Benefits from Various Sources of Services

Sources \ Benefits	Quick and Easy Access to Information & Technology	Reduced Production and Operating Costs	Solutions of Specific Problems	Shares Facilities	Stimulating Ideas	Help New Product Development/ Design	Improved Quality and Reliability	Enhanced Technical/Business Contacts	Other (specify)
1. Private contract laboratories	3		1	1	1				
2. Customers with long-term relationships	2	2	3		1	1	2	2	
3. Suppliers with long-term relationships	3	1	5		2	3	1	1	
4. Departments/Labs within your firm	2	2	3			3			
5. Foreign investors and licensors	4	2	2			2	1	1	
6. National technical institutions				2	2		1		
7. Local/regional technical institutions	3	1	1	5	3	1		1	
8. Consulting firms	2		4		3			1	
9. Universities and Technical Colleges	3		4	3	2	1			
10. Industrial Associations	5		3		1	1		5	
11. Academic Associations	1		1		1				
12. Research Associations	1	1	1			2	1		
13. Other (specify):_____									

Table 5.7
Problems with Various Sources

Problems / Sources	Fees are too High	Not Technically Able to Help You	Not Responsible in Timely Manner	Too Many Forms and Approvals	Lack of Personnel Continuity	Inadequate Protection of Confidentiality	Inadequate Facilities	Inadequate Rules of Ownership of Research Results	Too Far Away From Your Firm	Other (specify)
1. Private contract laboratories	-	-	-	-	-	1	1	1	-	-
2. Customers with long-term relationships	-	1	1	-	-	1	1	-	2	-
3. Suppliers with long-term relationships	1	2	2	1	1	1	1	-	1	-
4. Departments/Labs within your firm	-	2	2	-	1	-	2	-	-	-
5. Foreign investors and licensors	1	-	-	1	1		1		2	
6. National technical institutions	-	-	1	1	1	1	-	-	-	-
7. Local/regional technical institutions	1	3	5	2	1	1	2	1	-	-
8. Consulting firms	4	-	-	-	-	3	3	1	1	-
9. Universities and Technical Colleges	-	1	4	3	2	1	3			
10. Industrial Associations	-	4	-		1	3	2	2	1	-
11. Academic Associations	-	1			1			1		
12. Research Associations	-	1	1	1	1	1		1	-	-
13. Other (specify):_____										

Foreign investors and licensors, customers with long term relationships are the more used sources for various services.

The machine tool industry depends to a large extent on either itself or the collaborator for technical help. The technical services institutions are needed for testing and training. More sophisticated services like research and development are not demanded. This is because the technical service institutions perceive the Tis to be slow and theoretical.

Discussions in the field revealed the following prioritization of the sources of support for technical services.

1. Go to the collaborator if there is one. This would enable the company to transfer the technological risks to the collaborator or take a ready-made tested technology or solutions to problems.

2. Initiate in-house efforts through temporary task forces or R&D departments.

3. Augment the inhouse efforts with those of private consulting firms or retired employees of similar organizations.

4. Go to technical service institutions less risky and less urgent needs . Use the information or training related services and then move to other services like testing, standard and trouble shooting.

Negative perceptions regarding delays in delivery of services, bureaucratic culture within the TIs and lack of appropriate training and exposure to solve practical problems were strong. The TIs were seen as being more academic and less practice oriented. Some even felt that the TIs could learn from the industry. Industry gets the latest technology and supporting training from the foreign collaborators. This latest know how is not transferred automatically to the TIs. Platforms for sharing the experience with the TIs are not created either by the TIs or the industry. TIs do not have links with the firms acquiring latest technologies. TIs need to upgrade themselves through reading or industry oriented research. In the absence of this TIs are seen as unequal to large players. Consider the following comments by an executive of a large company which has grown with the help of both collaboration and technical efforts.

The contribution of training institutions can be seen from table 5.7.

5.3 Field comments on TI industry interaction

The following are some of the insightful comments heard during the field survey.

5.3.1 Industry respondents about TIs

We are far away from the TI, we are interested in. We wrote to the TI and requested them to visit us to understand our problems. They want us to go there. We feel that they do not understand our problems till they visit us. They are more concerned with ivory tower work than hands on experience.

TIs are good in theoretical training. They cannot solve practical problems. They need to learn from us.

Table 5.8

Perceived Contribution of Training Institutions

Contribution / Educational Institutions	1	2	3	4	5	Total
1. Government Vocational Institutions	7		2	1		10
2. Private Vocational Institutions	5		2	3		10
3. Universities	7	2	1			10
4. Industry Associations	5		3	1	1	10
5. Joint-Venture Partners	8			1	1	10
6. Buyers	9		1			10
7. Suppliers	8			1		
8. Other (please specify)						

TIs are too slow to respond. They have their own priorities.

We have better facilities for testing than TIs. Why can't TIs learn from us?

One or two individuals in TIs are good. They are in demand all the time.

We are afraid of approaching TIs. We are too small. TIs may ignore us.

Once they take interest they do a good job. Costs are secondary.

5.3.2 TIs about the Industry

The large companies are too impatient. They do not give us a chance to prove. Our credibility is always on test.

We are bound by our own rules, regulations and commitments.

Industry wants the services to be free. They should learn to pay for what they want.

Industry feels more comfortable in avoiding the technological risks associated with new introduction hence runs for foreign collaboration. We do not figure in their scheme of technology acquisition and development.

Companies "too busy" to go to the TIs.

While distance has been mentioned as one of the barriers to TI-Industry interaction, we came across mixed illustrations of the use of TIs by those who were located within the vicinity of TIs.

We came across an illustration where a company, located almost at the backyard of an educational institution made use of the institutions services continuously. 'Sponsoring student projects' was the main instrument for facilitating interaction. The student projects were meant for fulfilling the

requirements for completing the bachelor's or master's degree. Some projects were also sponsored for Ph.D. programmes. The success or failure of the projected the signal for initiating the interaction at the faculty level. There were instances where the faculty took active interest in the project and continued the interaction with the company.

Being located close to the TIs was an advantage for another company. It not only used the Tis for new product development but also developed on going contacts with them.

In another instance, however, a company discontinued the interaction with a closely located TI because the TI did not deliver what it promised.

A company has tried to bridge the theory-practice gap in an interesting way. It signed a three year contract with the TI for conducting a series of training programmes on quality management and insisted that the programme be conducted at the factory with the help of exercises developed from the situations faced by the company. The TI team had to visit the company several times to develop these exercises. This enabled both the TI and the company to understand each other better. Needless to say, the effectiveness of the training programmes was higher.

The above comments reinforce the nature of problems in TI industry interaction.

5.4 Comments on Small Sector use of TIs

Smaller companies expressed lack of awareness about the facilities and support TIs could offer to them. They also felt that TIs should go to the small sector rather than the small sector going to TIs. The small companies sought the support in training their workers in advanced technologies like CNC. One of the small companies interviewed by us mentioned that it was afraid for going to the TIs for help. One of the partners said: "We have grown in our own way. We do not know what they would think of us and our facilities. Besides, language of communication is a problem. We are afraid of approaching them. If they come to us with ideas to improve our business we would be glad to receive them."

A discussion with officials at two PDTCs concerned with the machine tool sector, and entrepreneurs of three small scale units located in the regions of a PDTC brought out the following achievements, opportunities and constraints.

* The concept of a PDTC is a unique concept. It is not only a source of trained manpower but also technical services like testing, prototype development and shared use of expensive equipment and facilities for production purposes. The success of these institutions depends on the customer orientation of the PDTCs, incorporation of the local industrial needs in their research activities and an appropriate balance between training, testing, prototype development in their mix of activities.

* PDTCs worked enthusiastically when they had support from foreign parties. They transferred drawings and prototypes to the small scale sector and new units came up in the vicinity of the centre.

* PDTCs have been a good source of trained technical man power. In addition to regular trade related courses, they have developed refresher courses to upgrade the skills of the existing work force in the small scale sector. They are located in the most appropriate places. They have sufficient space for expansion and modernization.

* PDTCs have brought out prototypes of new machines on their own after the expiry of the foreign technical collaboration but there were no takers from the small scale sectors. Either they were not needed or they were seen to be very expensive.

* PDTCs have developed a bureaucratic culture that is more concerned with sanctions, rules, regulations and working hours, time and not performance based promotions, absence of both rewards and punishment systems, than with the needs of the small scale entrepreneurs. This has led to neglect or delays in responding to the needs of the entrepreneurs and eventual withdrawal of support from the small scale entrepreneurs.

* In the activity mix of training, prototype development and research, training has emerged as a dominant activity. Research is inspired by the interests of the employees and resource availability and not by the needs of the local entrepreneurs.

* Local units approach the PDTCs when they have to get mandatory testing and calibrations to be done or when they have an equipment or facility which the small scale entrepreneurs can not install at their place owing to high cost or sophisticated skill requirement. It is felt that in providing these services the PDTCs can be more customer friendly and responsive.

* PDTCs have concentrated on 'protected business like furniture making' to earn revenue. The government departments need not go through tenders etc if they buy from the PDTCs. This has given continuous business to the PDTCs but taken their time away from prototype development and training.

* PDTCs have acquired new facilities like CNC trainer and computer supported materials analyzer but have not modernized existing facilities for testing and training. Rusted facilities co exist with sophisticated electronic equipments.

* The users adopt short cuts to save time and cost. They take the help of the PDTC employees out side office hours to get their work done.

* PDTCs can be useful if they reach out to understand the needs of the entrepreneurs and build their profile of activities, This calls for a business approach and not a bureaucratic one.

The above aspects of the working of PDTCs point to the need for rearticulating the old mission of the PDTCs, developing business like approach by providing sufficient autonomy in their choice of managerial practices and holding them accountable for results.

5.4 Role of Indian Machine Tools Manufacturers Association

From the field and mail surveys, it is clear that the Industry associations have played an important role in providing information , training support and taking delegations abroad for export promotion. IMTMA was set up in 1947. It has a membership of 328 companies manufacturing a wide range of metal cutting and metal forming machines, cutting tools, machine tool accessories and allied equipments. Of the 328 members, 212 members belong to metal cutting and metal forming machines. 152 members are from the small scale sector. The association develops position papers through its expert committees to deal with the special requirements of its members. These expert committees focus on themes like exports, small scale industry, financial institutions, government and industry interface, technology, customer service, supply and quality. The Association has its headquarters in Delhi. It is contemplating to set up an office in Bangalore that would provide secretarial assistance to the Machine Tool Design and Research Congress. The Machine Tool Design

Congress was started by the academic institutions associated with Machine Tool engineering. One of the significant activities of IMTMA has been the organization of an exhibition of machine tools manufactured in Indian and abroad. It provides opportunity for the Indian manufacturers to display their new products. Awards are given to the best design.

5.4.1 MOU with CMTI

Recently, it has entered into a memorandum of understanding (MOU) with CMTI for providing laboratory services, seminar, support, CAD and CAM training, TQM, technical services, group visit, and exhibitions. It has also worked with the National Institute of Design for designing machine tools for exports and the Indian Institute of Packaging for improving the packaging of machine tools for exports. The demonstration of packaging methods developed by IIPA are held at various factories. Bangalore office would be called IMTMA technology centre. The Association has linkages with its counterparts in Japan, USA and Germany. Exhibit 1 provides an idea of the Association's activities.

6. Some Questions For Industry, TIs and Policy Makers

The competitive environment after the liberation has brought out the weaknesses of the Indian machine tool industry to the surface. Low risk orientation, compartmentalisation of learning from collaborations, and high cost operations have created barriers to competitive internalization.

With the liberalization, foreign companies would tend to set up their own units rather than provide collaborations to Indian companies. In the future, therefore, if the Indian companies have to succeed, they have to succeed on the strength of their own R & D, or with a strong linkage with the TIs. This creates opportunities for TIs to collaborate with the industry in less used areas like development of new products and technologies. This calls for a shift away from bureaucratic orientation to marketing orientation and from only teaching orientation to teaching and learning orientation.

With the increase in the threat of imports, decreasing export competitiveness, fast changes in the demand mix and technology of manufacture the domestic machine tool industry, especially the large company segment is at the cross roads. There is an urgent need to develop internal strengths and greater collaboration with technical institutions to survive and grow.

The findings of our study pose certain questions to the industry. TIs and policy makers. Discussion of these could yield the priorities for them. The key questions are listed below.

What should be done to enhance the domestic and international competitiveness of Indian machine tools industry?

How do we build the new strengths required to become cost competitive and at the same time increase the speed of new product introduction?

What kind of interaction can facilitate learning from each other and within a firm from each product experience?

How do we sustain the usage of the most used services like information services, education and testing and training? How can these be used as a platform for launching other services?

How to enhance the reach of the TI services considering that the overall usage of TI services is less than average?

What is an appropriate marketing and financing strategy for the TIs?

How to increase the utilization of less used services like collaborative R&D, new product development etc?

How do we build the confidence of the Indian companies to take technological risks? Can an internal ventures fund help?

What is an appropriate platform for cross fertilization of the experience of TIs themselves and between the Tis and the industry?

How do we upgrade the facilities of TIs and imbibe the customer orientation and move away from bureaucratic orientation? How can we make the industry TI friendly or TIs industry friendly?

7. Conclusion

In this report we presented an overview of the machine tools industry and the findings of the mail and field surveys. We found that the machine tools industry had grown to produce the widest range of machine tools with the help of collaborators, own efforts and technical service institutions. The government of India had played a significant role as a policy maker, entrepreneur and institution builder in developing the industry. Initially, the government adopted protectionist policies. This was liberalized in the mid seventies and eighties. The industry was called upon to develop competitive capabilities to face competition from new entrants in the domestic industry and imports in the domestic market and successful players in the international market.

The overall usage of the technical services by the industry was moderate. The most used services were standards and testing, education and training and information services. The industry association had played a meaningful role in offering information services. The demand for R&D services came from the small and medium sized companies. The TIs had played a moderate role in significant product and process changes. The companies tended to rely more on inhouse efforts or collaborators than the TIs. There was scope for the TIs to learn from the experience of the large companies in the industry. The most used government policies were those that related to fiscal benefits and exports.

At the time of our study we found the industry at the cross roads. It was felt that the government, TIs and the industry could work together to build the competitive capabilities of the industry.

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Exhibit 1

Range of Machine Tools Produced in India

GROUP A

Automatics
Lathes
Boring Machines
Broacing Machines
Drilling Machines
Tapping & Threading Machines
Milling Machines
Planing Machines
Shaping Machines
Slotting Machines
Gear Cutting Machines
Grinding Machines
Lapping/Honing & Polishing Machines
Sawing & Cut-off Machines
Bending & Straightening Machines
Folding Machines
Press Brakes
Presses
Punching Shearing & Cropping Machines
Nibbling Machines
Other Metal Working Machine Tools
Metal Forming Machinery
Forging Machines
Spark Erosion Machines
CNC Lathes/Chuckers
CNC Turning Centres
CNC Milling Machines
CNC Drilling Machines
CNC Grinding Machines
CNC Boring Machines
CNC Gear Gutting Machines
CNC Wire cut EDMS
CNC SPMS
CNC Presses
CNC Boring and Turning Centres
CNC Shearing Machines
CNC Pipe Bending Machines
CNC Honing Machines
CNC Boring & Milling Centres
CNC Vertical Machining Centres
CNC Horizontal Machining Centres
Robots
Special Purpose Machines
Machine Tools (NES)

GROUP B

Welding & Gas Cutting Machines
Plastic Injection Moulding Machines
Die Casting Machines
Testing Machines
Hydraulic Equipment
Portable Electric Tools
Portable Pneumatic Tools
Machine Tool Accessories/Attachment
CNC Systems
CNC Equipment
Digital Readout Systems
Induction Heating Equipment