

# **Indian Machine Tool Industry Vision Document & Perspective Plan 2010 - 2020**



**August 2010**



**Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
Government of India**

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**Report of the Sub-committee of the  
Development Council for Machine Tools**

**August 2010**



सत्यमेव जयते

**Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
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# **Indian Machine tool Industry: Vision & Perspective Plan 2010-2020**

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## Foreword

The Indian machine tool industry, while emerging from a protected economy to a liberalized economy, has seen ups and downs, as any other industry. The unexpectedly rapid growth of the auto, auto component and aerospace industry has raised demand for the latest technology machines. The common quest for cost competitive manufacture has led to the adoption of high productivity machine tools and machining practices. The rise of the consumer goods industry has spurred the demand for metal forming machines in a big way.

The machine tool industry has had to respond on several fronts at once! It has also to combat increased imports. While the industry has taken several measures to meet these challenges, it requires certain fiscal, physical and policy initiatives to overcome its constraints and put the industry on a long term development and growth path.

We are greatly encouraged by the recognition of machine tools as a **strategic industry** and its inclusion among the capital goods industries for measures to improve their competitiveness. The Department of Heavy Industry convened a meeting of the reconstituted Development Council for Machine Tools on 9<sup>th</sup> March 2010 to discuss the issues faced by the industry. A sub-committee was constituted to study these in detail and make appropriate recommendations to the government. This Perspective Plan is the result of the deliberations of the sub-committee. It addresses all issues that are important to this industry and sets down the Vision and Mission for the next ten years, during which period the industry should aspire to grow to ten times its present turnover. Even though the machine tool industry is comparatively small, it holds the key to sustained manufacturing growth and competitiveness, besides playing a key role in national security in the strategic sector.

This report enumerates the measures that would be required for technology development, capacity building, stimulating demand and attracting investment to this industry. I am pleased to place this report of the sub-committee before the DHI for the consideration of the government.

I thank Shri. B. S. Meena, Secretary, and Shri. Harbhajan Singh, Jt. Secretary, Heavy Industry for their valuable suggestions in formulating this Perspective Plan. I am sure that their initiative and support will see the implementation of these recommendations and lead to a dynamic growth path for the Indian machine tool industry.

I would also like to thank members of the Development Council for Machine Tools, the sub-committee members and my senior colleagues in the industry who have given their inputs during the course of this work. I am indebted to Mr. **V. Anbu** and Mr. P. J. Mohanram of IMTMA for piloting this effort and the IMTMA secretariat for bringing out this document.



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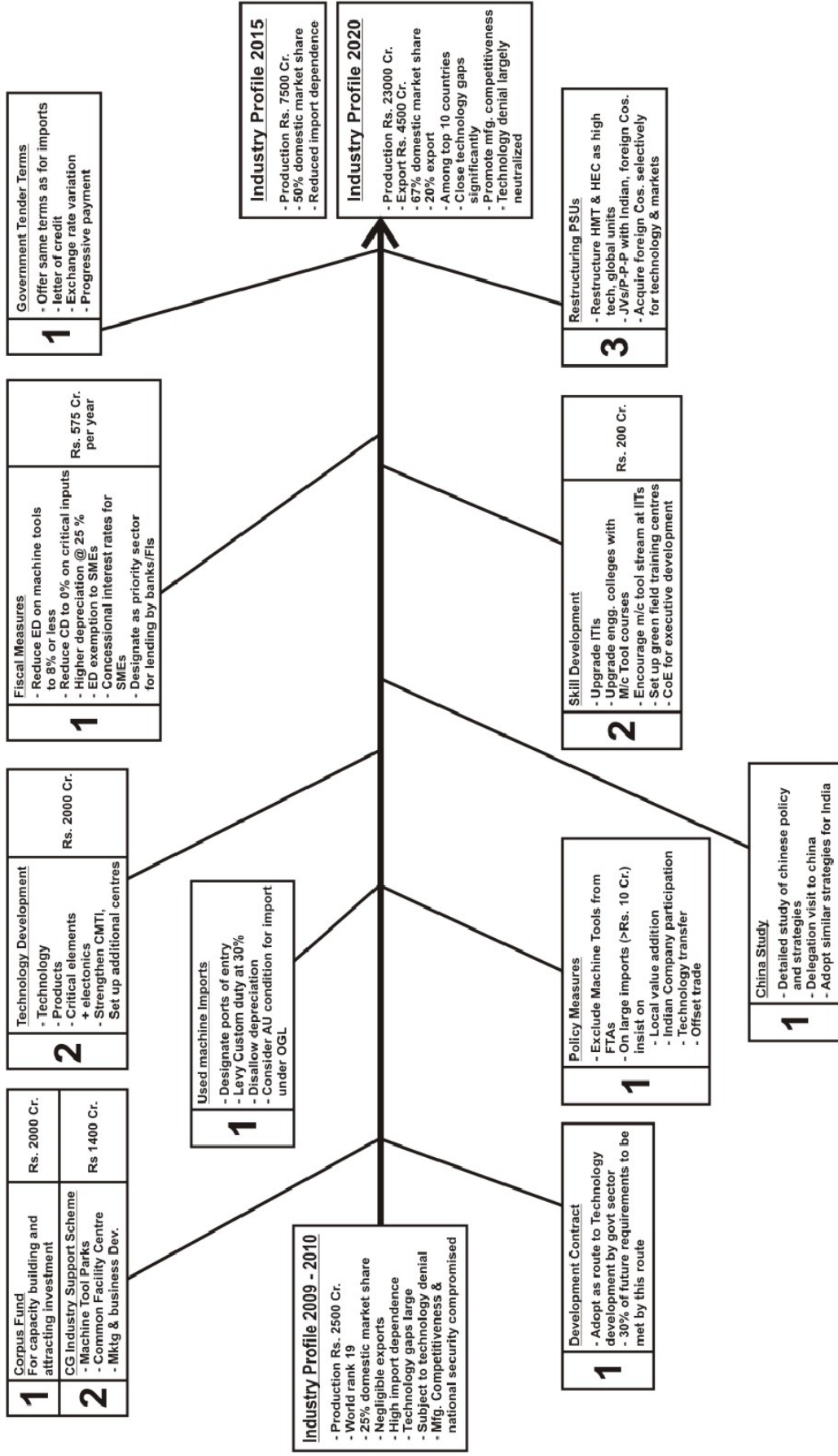
11<sup>th</sup> August, 2010



# Recommendations at a glance

## Roadmap for the Indian Machine Tool Industry 2010 - 2020

(Note : Numbers denote priority)



## Executive Summary and recommendations

The following is an executive summary of the recommendations/ suggestions of the report:

### 1. Machine tools is a strategic industry:

The machine tool industry is a strategic industry which plays a vital role in the economic growth through its multiplier effect. It determines the manufacturing competitiveness in important sectors such as automobiles, consumer goods and others. Machine tools play a vital role in countering technology denial in strategic sectors such as defence production, aerospace and nuclear. A strong machine tool industry is essential to realize ambitions in manufacturing growth, provide sustained manufacturing competitiveness and ensure national security. **The machine tool industry has been recognized as a strategic industry in NMCC's report to the PMO.**

### 2. Machine tool industry Vision and Mission:

Drawing from stated objectives of 12-14% growth and 30% contribution to the GDP by 2020 from the manufacturing sector, the Vision for the machine tool industry may be stated as:

#### VISION

- **Develop machine tool technology and raise production to reduce import dependence, counter technology denials, provide sustained manufacturing competitiveness and strengthen national security.**

Although India is one of the larger consumers of machine tools, the indigenous machine tool industry holds only around 30% of market share. This is due to the fact that user industries depend on imports for several types of machine tools. The primary mission of the domestic industry would be to arrest its erosion of market share, which in turn would make the industry improve its other characteristics and standing globally. Drawing from this, the Mission for the machine tool industry could be set down as:

#### MISSION

- **Secure a domestic market share of 50% in five years and 67% by 2020;**
- **Become one among the top 10 machine tool producing nations of the world**
- **Raise exports to a significant level of at least 20%**

### 3. Machine Tool Demand projection:

The demand for machine tools has been estimated through several approaches to arrive at a figure with a fairly high confidence level. The approaches used are:

- a. Based on the information provided by various capital goods industries on their capital investments over the next five years;
- b. By extrapolating from machine tool consumption data for the last 10 years, which includes years of high growth as well as dips caused by downturns, as in 2008-09, for example.

From these several approaches, the indicative aggregate machine tool demand (consumption) over the next five years is estimated at around Rs.60,000 to 70,000 cr. It is also necessary for production to grow at 25% CAGR to meet the targets in the Mission for the industry. The projected demand and production figures for the next two five-year blocks are given in the table below:

(Rs. Crores)

Year	Demand	Production (25% CAGR)	Year	Demand	Production (25% CAGR)
2010-11	8382	3100	2015-16	16860	9450
2011-12	9639	3870	2016-17	19390	11812
2012-13	11085	4840	2017-18	22300	14765
2013-14	12748	6050	2018-19	25640	18457
2014-15	14660	7560	2019-20	29300	23080
Total	56514	25420	Total	113490	77564

#### 4. Technology expectations and gaps:

The machine tool industry has good design and manufacturing competence for a wide range of products. However the product range and the technologies manufactured in India have a substantial gap with the present levels abroad. The user industries expect the latest technologies to produce high quality end products at competitive prices. This has made it imperative for the machine tool industry to take an inventory of present technologies and those it should develop within a five year time horizon. These are summarized in the table below.

Particular mention may be made of the need to develop indigenous manufacture of critical mechanical and electronic elements that are the “heart” of CNC machines, for which the industry is entirely dependent on imports. The industry is also subject to technology denials on these elements as well as for the higher technology machine tools. This is a potentially serious weakness which must be overcome.

Existing Technology	5 Year Development perspective
<b><u>Existing:</u></b> <ul style="list-style-type: none"><li>➤ Non CNC general purpose machines</li><li>➤ Standard CNC machines</li><li>➤ Gear cutting, Grinding</li><li>➤ Medium sized machines</li><li>➤ EDM, Wire-EDM</li><li>➤ SPMs</li><li>➤ Medium size machines</li><li>➤ Presses, Press Brakes</li><li>➤ Pipe Bending</li><li>➤ Hydroforming (limited)</li><li>➤ Servo presses (limited)</li><li>➤ Rolling, Bending</li><li>➤ Measuring, metrology and gaging</li><li>➤ Drives and controllers (limited)</li></ul>	<b><u>To be developed:</u></b> <b><u>Metal cutting machine tools:</u></b> <ul style="list-style-type: none"><li>➤ Multi-axes, Multi-tasking machines</li><li>➤ High precision machines</li><li>➤ Large machines (boring-milling, turning)</li><li>➤ Gear cutting and finishing machines</li><li>➤ Grinding technology and machines</li><li>➤ Electrical and micro-machining</li></ul> <b><u>Metal forming machines:</u></b> <ul style="list-style-type: none"><li>➤ Higher press automation and transfer systems,</li><li>➤ Servo presses,</li><li>➤ Sheet working machines (including laser, waterjet heads)</li><li>➤ Hydroforming,</li><li>➤ Fine blanking</li><li>➤ Forging machines.</li><li>➤ Flow forming</li></ul> <b><u>Special technologies:</u></b> <ul style="list-style-type: none"><li>➤ Explosive forming,</li><li>➤ Electro-magnetic forming etc.</li><li>➤ Cutting tool technologies</li><li>➤ Robotics and automation</li><li>➤ Alternative materials (epoxy granite etc.)</li><li>➤ Thermally stable welded structures</li><li>➤ Hydrostatic spindles, guideways</li><li>➤ Motorised and high frequency spindles</li><li>➤ Smart machines with embedded sensors</li></ul> <b><u>Critical components development:</u></b> <ul style="list-style-type: none"><li>➤ Anti-friction linear guideways</li><li>➤ Ball screws</li><li>➤ Precision spindle and ball screw support bearings</li><li>➤ CNC controls</li><li>➤ Spindle/axes servo motors with controllers</li><li>➤ Feedback measurement systems</li></ul>

An action plan for technology development is presented along the following lines:

- a. Form a high powered Machine Tool Technology Committee with representation from all stake holders and policy and finance agencies of the government
- b. Draw up detailed R&D projects, considering not only the development phase but also the marketing phase to take the developments commercial
- c. Strengthen CMTI establish its presence in other regions;
- d. Set up a separate financing mechanism for the program
- e. Select the machine tool companies which will participate, and also draft the CMTI into the program;
- f. P-P-P companies: Government, machine tool industry and R&D/Technology sources may form p-p-p companies to address special areas like critical components for machine tools and CNC/machine tool electronics. These companies will develop and commercialize the technologies; government would underwrite the R&D costs.
- g. Promote the risk sharing "Development Contract" route by large government and private buyers as a route to development;
- h. Implement and monitor the program through the high powered committee

<b>A rough estimate of development cost of new technologies and products</b>
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<b>Rs. 2000 crores</b>
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## 5. Fiscal and policy measures :

In a Roadmap for the industry presented to the ministry, NMCC and the Planning Commission in February 2010, IMTMA had identified the following immediate and short term measures required to support the industry which may receive immediate attention of the DHI and Government of India:

### a) Fiscal measures to reduce the cost and hence the price of machine tools:

- a. Reduce customs duty to zero percent on all critical elements
- b. Reduce Excise Duty on machine tools from the present 10% to 8% or even less,
- c. Introduce a system of "pass through" MODVAT
- d. SSIs may be given loans on easy interest rates at 6% for purchase of new machine tools
- e. Exempt or reimburse excise duty to small scale manufacturers
- f. Allow higher rate of depreciation at 25% on Indian machine tools
- g. Treat machine tools as "priority sector" for financing;
- h. Interest rates: The Indian machine tool industry suffers a major disadvantage on interest rates when compared with foreign manufacturers:
  - Interest rate in India: 14-16%
  - Interest rate abroad: 2-4%

This in itself adds to the cost of Indian machine tools, making them non-competitive against imports by at least 10%. In addition,

- Foreign manufacturers offer deferred LC payments of 1-2 years placing Indian machine tool companies at a major disadvantage.
- While foreign companies can raise working capital loans at 2-4 % interest on LCs, Indian machine tool companies do not get such LCs from buyers, and raising finance even at 14-16% is difficult.

Government may seriously address these difficulties and come up with remedial measures to create competitive conditions for the Indian machine tool builders.

The implementation of these fiscal measures is estimated to have a financial implication of approx. Rs. 575 crores per year. However, this must be weighed against the increased demand for machine tools which will generate greater entrepreneur activity, employment and contribute to manufacturing productivity especially among SMEs.

**Policy measures:**

- i. Modify government tender terms (Railways, DGOF, BHEL, PSUs etc) to include payment by LC /progressive payment and Exchange rate variation to Indian machine tool companies. Also relax conditions of “previous supply”.
- j. Exclude machine tools in FTAs;
- k. Impose technology transfer condition on imports:
- l. Introduce an Offset trade condition on foreign suppliers of machine tools above say Rs.10 cr value.
- m. Acquisition of companies abroad: One way of obtaining technology is by selectively acquiring leading international companies. The optimum way to do this would be through JVs of government and private companies but ensuring the commercial autonomy of the resulting venture through suitable equity ratios and management structure. Government may consider this.

**6. Capital Goods Industry Support Measures: Machine Tools:**

For reasons already discussed the entry of new investors into machine tools is not very likely, and the growth of the industry will have to be through support and encouragement to existing companies. As this cannot be done for individual units, the government’s plan to support capital goods at the industry level is very appropriate and welcome.

These should aim at an integrated development of the industry majors along with the smaller units and thereby bring synergy between them for the betterment of the industry. It is in this context that the support measures have been structured along the following lines:

**a. Machine Tool Parks:**

The Machine Tool Park (MTP) that is being conceived now is a modern version of the industrial estate of the past. The MTP is expected to host a few (say 1-3) machine tool companies making the final products. The rest of the units in the park would supply components, sub-assemblies and services to the main units to the latest design and technology. In addition, the park is conceived to have the entire auxiliary serviced required to complete the machine tool producing chain from order to dispatch.

The estimated investment in a Machine Tool Park to create the infrastructure is around Rs.250 cr. Such a park would support 1-3 main machine tool units and 60-100 SMEs depending on the nature of the units. Such MTP may preferably be in the vicinity of existing machine tool clusters or even away, say 100-200 km or so, provided good connectivity exists.

Three Machine Tool Parks may be considered, one each in the south, west and north to serve the major machine tool producing locations in India. The total investment in setting up the park infrastructure is Rs.750 cr.

**b. Common Facility Centres:**

The development and upgradation of the machine tool units, especially the smaller ones, can be considerably strengthened by setting up Common Facility Centres (CFC). These CFCs will provide certain critical manufacturing facilities which the individual units would not be able to afford.

CGFCs would have to be in the vicinity of existing machine tool clusters. The estimated investment in setting up a CFC is around RS.200 cr. This includes the specialized machinery and equipment to provide services to the SMEs. These would be on chargeable basis, providing a revenue model for the CFCs.

Three CFCs, one each in the south, west and north may be considered. Investment is Rs. 600 cr.



**c. Business and Market Development support:**

This is in the nature of soft support to clusters of companies to improve internal efficiencies, implement IT, lean manufacturing concepts, market development and the like. An allocation of RS.50 cr over 5 years may benefit the machine tool companies in attaining overall improved performance.

A summary of the suggested outlay under the CGI Support scheme of the DHI is given below:

	<b>Approx. investment Rs.Cr</b>
<b>Machine Tool Parks (3)</b>	<b>750</b>
<b>Common Facility Centres (3)</b>	<b>600</b>
<b>Business &amp; Market Development</b>	<b>50</b>
<b>Total</b>	<b>1400</b>

**7. Corpus Fund for the Machine Tool Industry:**

It has been pointed out that fresh/expansion investments into the industry will have to be attracted through suitable measures. One such measure suggested is the creation of a Revolving Corpus Fund of at least Rs.2000 cr to facilitate such capital investment. This will be in the nature of soft loans with reduced interest rates and will require equal investment by the benefiting company. Such a scheme would make it possible for more machine tool companies to substantially add capacity to take advantage of the expected demand growth.

<b>Revolving Corpus for machine tool industry</b>	<b>Rs.2000 cr</b>
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**8. Skill development:**

The machine tool industry has seen rapid changes in technology over the last two decades which has resulted in both an erosion of skills among existing employees and the non availability of new entrants with the required skills.

Correcting this situation will require a systematic approach to identify present weaknesses, new requirements and then come up with a plan to bridge these gaps through suitable measures. The skill gaps need to be filled not only at the worker level, but it should address supervisory and management positions as well. An important component is to develop the educational and training establishments to address the specific requirements of the machine tool industry.

The following course of action is recommended:

- NSDC may make an in-depth study of the skill gaps and needs;
- Draft new curriculum for certificate, diploma and graduate courses specifically oriented towards machine tool technology.
- Introduce new courses in machine tool technology in engineering colleges, IITs and similar institutions.
- Include CMTI in designing and running higher degree courses in machine tools and manufacturing technology.
- Set up training institutions exclusively for machine tools, with machines, equipment and tools to impart practical training and knowledge
- “Train the trainer” programs are very essential. The teaching staff at our ITIs and colleges should also receive training in modern machine tool technology.

- Support IMTMA to set up training facilities
- The training of machine tool industry executives should not be lost sight of. It is suggested that a Centre of Excellence for developing managers, leaders and visionaries for the industry be set up which will serve the entire manufacturing industry in the country by adopting the VLFM program which is currently being run by CII in cooperation with NMCC.

These training establishments may be set up along the models of the the PROSchool set up by AFM, the Toyota Technical Training Institute at Bidadi and the German model of education with industry attachment which is very successful. A detailed study would be required to identify the facilities and prepare investment estimates.

A rough estimate of the investment in upgrading ITIs, engineering colleges and setting up Greenfield training centres and Centre of Excellence for executive development is around Rs.200 cr.

<b>Training and skill development</b>	<b>Rs.200 cr</b>
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## 9. Summary of suggested measures and the corresponding financial outlay is given below:

A summary of the various measures as given in the above sections is given below:

	Suggested measure	Financial outlay (Rs. Cr)	
		Total	Per yr
1	Technology/R&D	2000	
2	Capital Goods Industry Support Scheme: Parks (750) + CFC(600) + Business development (50)	1400	
3	Revolving Corpus Fund	2000	
4	Skill Development	200	
	<b>Total outlay required from government</b>	<b>5600</b>	<b>1120</b>
5	<b>Revenue implication of fiscal measures suggested (per year)</b>	<b>575</b>	<b>575</b>

These investments must be viewed in the long term perspective for the growth and development of the industry, particularly in the light of an anticipated demand of Rs.60,000 crores + for machine tools in the next five years. This relatively small investment is also vital in developing the manufacturing competitiveness and national security of the country, especially to counter technology denial regimes which affect our strategic sectors. The outlays towards machine tool parks, common facility centres etc. may be recovered partially at the time of sale of industrial plots in the Technology Parks and through charges for services rendered at the CFCs. The initial investments in all the areas above may be seen as a catalytic measure by the government.

## 10. Imports including used machine imports:

The import of new and used machines are mainly in grinding, gear cutting, metal forming and boring/milling machines. These imports provide an opportunity to the Indian machine tool industry to invest in capacity and development of new products to meet the rising market demand. As India produces only limited output of these machines, an outright ban on import of used machines is not considered advisable. However, some measures to discourage and curb import of obsolete machines are in order:

- a. Channelize used machine imports through two designated ports for proper data collection and monitoring;

- b. Levy a uniform custom duty of 30% on used machine imports
- c. Disallow depreciation on used machines
- d. Impose “Actual user” condition on imports of used machines under OGL.

### **11. Restructuring HMT And HEC:**

HMT Machine Tools and HEC are PSUs with potential for becoming leading machine tool companies in India and even global companies. It requires a very detailed study to come up with an action plan for their restructure. As the government has constituted a team to study their restructuring, the following suggestions are submitted for consideration:

- a. Together, HEC and HMT together have the potential to reach an annual turnover of around Rs.1500 cr. which may be kept as a target while restructuring the companies.
- b. Both companies require selective modernization of the production facilities and manpower restructuring.
- c. The restructuring process may seriously examine joint ventures with leading manufacturers abroad both to infuse latest technology to access the domestic and international market. As an alternative, the government could consider creating conditions for acquiring select foreign companies having synergetic possibilities with HMT units and HEC
- d. Consider making each unit of HMT and HEC independent companies with specific product/technology focus and JVs/acquisitions of foreign companies. The restructuring process may be driven by a vision to make each of the units an international company in its own right.
- e. Government may divest at least 51% in these companies and make these companies entirely board managed. This would pave the way for JVs/acquisition of foreign companies and may also attract Indian investment into these companies

### **12. Lack of large investor interest in machine tool industry:**

This is due to the following reasons:

- a. Specialized skills make this industry “difficult”
- b. High investment with long gestation periods
- c. Large technology gaps and strong imports create uncertainty of market demand
- d. Profitability not very high, except in volume manufacture, which needs heavy investment
- e. Whole industry is of small size. A new entrant may expect a turnover of around Rs.400-500 crores, and a profit of around 10%, which is not attractive for large business houses

These factors have inhibited investments by any large house. It is equally a pointer to implement measures to attract investment into the industry.

### **13. Technology denial:**

Components in aerospace, defence, medical, instrumentation and nuclear industries have complicated profiled components which require simultaneous interpolation in 4, 5 or more axes. The export of CNC machines/systems with such capabilities is refused by the German/Japanese governments. There have also been instances when CNC machine tools meant for use by the machine tool companies have been refused export permission, if these machines exceed certain accuracy limits fixed.

The denial of these machines/CNC systems is done under the guidelines contained in the IAEA Circular INFCIRC/254/REV.7/PART 2 of March 2006 (Annexure 8) as a dual use equipment. It has placed the machine tool industry in a serious situation of uncertainty while responding to machine tool requirements from the strategic sectors in India. *It also affects the national security of the country.*

The following measures are recommended to overcome the technology denial regime:

- a. The Government of India may take up this issue seriously with the concerned governments to exclude India from the application of the IAEA Guidelines. It would be inconsistent to apply these guidelines to India after signing special agreements with IAEA on nuclear technology.
- b. Develop PC based systems with motion control cards and the software to realize the CNC capabilities. Servo drives and motors have to be sourced from independent manufacturers of which there are many internationally. This is a relatively easy and low-risk route that does not require the development of any hardware. With an increase in demand for such machine tools the development of this solution can be a viable proposition eventually; however the government should underwrite the development project costs.
- c. The development of high technology multi-axes machine tools should be pursued under the R&D/Technology Development program in sec.5 and funded through a separate mechanism.
- d. Developing the critical mechanical elements:
  - Ball screws
  - Anti-friction Linear Guideways
  - High precision spindle and ball screw support bearings
  - Measuring systems.

There is no alternative but to develop this technology through R&D. It is best done through a development-cum-manufacturing JV of machine tool companies, R&D institutions and an R&D group with the government underwriting the development phase costs. This should be part of the R&D/Technology Development program enumerated in sec.4.

#### **14. The Chinese strategy for machine tools:**

In giving a new thrust to the Machine tool industry along several fronts, the strategy adopted by the Chinese government may be of great interest. These may be summarized as below:

- a. China has declared the internal development of precision CNC machine tools as one of the country's strategic needs and targets over the next 15 years
- b. Chinese government document has stated that China should reduce its reliance on imported CNC machine tools by developing its own machine tools and computer control systems.
- c. Chinese government has identified types of machine tools that it plans to build domestically over the next five years.

The Chinese also follow a carefully crafted strategy while attracting foreign investment, which is designed to ensure eventual technology transfer. Selective acquisition of foreign machine tool companies is adopted by the Chinese to get advanced technology and markets at one stroke.

**Study of the Chinese machine tool industry:** The DHI may support a study of the Chinese machine tool industry by financing the study which should be carried out by an agency having good access to Chinese industry, trade and government. The study may involve an investment of around Rs.50-70 lakhs.

# 1 Machine tools: Strategic industry for manufacturing competitiveness and national security

Industrial progress depends almost entirely on the manufacturing strength of nations. The dominance of western nations was due to their manufacturing strength, built assiduously over the last two centuries. This gradually shifted to the countries of the east, starting with Japan, then Korea, China and now India. It is no accident of history that as the eastern nations have gained in manufacturing strength they have gained economic power and political influence. Simultaneously, the erosion of manufacturing prowess in the US and Europe has seen a corresponding reduction in their economic and political clout. As India bids to take its rightful place in the world, it has to shift to a manufacture driven economy no less than agriculture and services.

It is in this scenario that the Indian government has drawn up several plans to raise manufacturing content and competitiveness in the economic growth of the country. The results are there for everyone to see: from nearly zero, the Indian automobile industry bids fair to become the world manufacturing hub for small cars; the consumer durables industry is booming and did not see a slow down even during 2008-09; there are strong investment plans by the world's leading auto and other manufacturers to increase their production base in India.

One factor that is often missed is that behind manufacturing success lies a core industry: **machine tools**. This industry provides the actual manufacturing muscle to all other industries. Machine tools are the "mother machines that build all other machines". It provides the critical inputs to the defence, aerospace and nuclear industries for making the components and systems required for these sectors. Gratefully, India has a reasonably developed machine tool industry which has been supporting these strategic sectors with the machinery required, often countering technology denials from the advanced nations.

The importance of machine tools to the manufacturing sector will be obvious from the following:

- **Automobiles:** India is fast becoming an important auto manufacturing destination, especially for compact cars and two-wheelers, but also for transport vehicles and tractors. This has been possible because of the competitive advantage that India has provided. So far, this competitive advantage has been through a mix of lower labour cost and productivity improvements. However, the industry relies heavily on imported machine tool technology in certain areas to gain advantages in productivity and quality.

The continued growth of the auto sector will require building a sustained competitive advantage through various measures, of which machine tool technology is a primary input. Continued dependence on imports will at some time prove to be a major drawback: it can erode cost advantages, and the industry may also be exposed to barriers in obtaining the latest and most productive technologies as other countries scramble to revive their automobile industries for industrial and economic growth.

A strong Indian machine tool industry will be necessary to counter such threats by providing cost effective, low-priced, high-tech machine tools to Indian auto manufacturers with quick deliveries and efficient service back-up. If the country does not build this machine tool capability, the Indian auto industry may well stagnate after the period of high growth witnessed now.



- **Strategic sectors:** The importance of the latest machine tool technology to strategic sectors like defence, aerospace, nuclear sectors and industries feeding these sectors cannot be over emphasized. With rapid developments in the technology of these sectors, these industries require machining of complicated components in new materials to high precision. This requires machine tools with multi-axes capabilities, multi-function machines with high precision, controlled by the latest computer numerical control (CNC) systems. These are being subjected to technology denial from advanced countries even now. Our strategic sector industries are unable to import latest technology machine tools due to refusal of export permission by foreign governments under their policies. Not only this, Indian machine tool manufacturers are denied CNC systems with multi-axes capabilities. Some instances are:
  - Machine tool company denied 5 axes CNC for tool making applications under “dual use” clause;
  - Machine Tool Company denied large gantry-milling machine from Japan since accuracy levels exceeded an arbitrarily fixed (low) value under IAEA dual-use clauses.
  - Machine tool companies have to give declaration that the controls imported by them will not be used for the manufacture of weapons. Such declarations are to be accompanied by end-user identification with location of the machines.
  - Flow forming machines have been repeatedly denied to DGOF/DRDO. This technology is vital for manufacturing rocket/missile cases, nose cones and other critical components.
  - Where imported machines are installed in strategic industries, service is often delayed to attend to such machines.

The control on sale of machine tools under the “dual use” clause is very stringently applied against “entities” such as the DAE, ISRO, DGOF, R&D establishments **and even key civilian industries** which supply components and systems to these organizations. This often results in delays and difficulties in executing projects of national strategic importance.

It is obvious from the foregoing that the machine tool industry in India needs to be strong and technologically advanced if India has to realize its full potential in automobiles and other industries, and secure the strategic interests of the country against technology denial regimes.

It is also pertinent to point out that China has placed strong emphasis on development of the machine tool industry in its 11<sup>th</sup> Plan, and set out long term objectives for the industry. Essentially, it seeks to develop high tech machine tools and controls, and reduce its import dependence drastically, and eventually export these machines. China has adopted a combination of strategies to ensure technology transfer in machine tools, including acquisition of leading international machine tool companies with advanced technologies. (More in Sec.15 of the report)

Machine tools have a profound effect on the economy in terms of its multiplier effect. It has been estimated that investments in machine tools have a multiplier effect of 1:100 on the ultimate output of industry. Thus the investment in machine tools (i.e., consumption) is a very valid indicator of economic and industrial growth. A growing economy requires a strong investment in machine tools. It is therefore very encouraging to note that the government has recognized the strategic role the machine tool industry plays, and included this among the capital goods industries which have been identified for special attention for their growth and development.

The NMCC – PMO Report of Sept. 2008 has identified capital goods among five manufacturing sectors as “strategic”. Machine tool is one of the capital goods sectors. The report further goes on to say: “from the strategic point of view support the following industries with focused attention: (1) Machine Tools ...” The report further recommends: “In each of these sub-sectors, a time bound action plan should be prepared for building high class modern capacities with R & D facilities in line with the requirement of meeting the long term strategic demands of the country. The plan would contain policies and programmes which would encourage growth and development of these sectors in the private sector while strengthening the existing public sector. Competitiveness should be the touchstone for Governmental support.”

Therefore, out of the several initiatives have been drafted by the government, this is a much needed step to strengthen the ***machine tool industry, one which is a strategic industry in its own right, that determines the manufacturing competitiveness and national security of the country.***

## 2 The Machine Tool Industry Vision & Mission

India has defined its ambitions for the manufacturing sector:

- To raise contribution from manufacturing sector to the GDP from 17% at present to 30-35% by 2020 (NMCC Strategy Paper 2006)
- To attain a growth rate of 12-14% in manufacturing (NMCC)
- To make India a Global Automotive Hub (Automotive Mission Plan 2006-2016)

These objectives in fact define a vision for the manufacturing sector which is expected to raise employment and income levels all round. One of the key *inputs* to achieving this is obviously machine tools. The “mother machines” are the prime enablers to build “other machines” which in turn make every single manufactured item. It is therefore appropriate to set down a Vision for the machine tool industry to support the vision for the manufacturing sector.

The machine tool industry is critical to the manufacturing competitiveness and national security of the country. It is a weakness that our country does not produce the more advanced, high precision machines to support our strategic sectors besides others. It is therefore not surprising that the industry has only a 30% market share, the rest being filled by imports. These shortcomings have to be removed if the machine tool industry has to play its rightful role in manufacturing competitiveness and national security. This requires a national level visionary approach, much like the Indian nuclear or space program.

**The Vision for the machine tool industry could be set down as follows:**

### **VISION**

**Develop machine tool technology and raise production to reduce import dependence, counter technology denial, provide sustained manufacturing competitiveness and strengthen national security.**

The above Vision should lead to specific Missions for the machine tool industry, which are derived as below:

## Mission for the Indian machine tool industry:

The present position of the Indian machine tool industry is summarized below:

Year: 2009	\$ bn	Rs. Cr	Remarks
World production	55	2,47,500	(@ \$1=Rs.45)
India Consumption	1.16	5220	India production 0.50% (Not adjusted for figures outside IMTMA) Not significant
India Production	0.27	1215	
India Exports	0.012	54	
India Imports	1.48	6600	
<b>World rank – consumption</b>	<b>8</b>		
<b>World rank – production</b>	<b>19</b>		

(Source: 2010 World Machine Tool Output and Consumption Survey; www.gardnerweb.com)

(Also see comparison with China on page 63)

Considering the very small share that India holds in world production, there is ample scope for the growth of the industry not only domestically but also internationally. More significantly, the low domestic market share of around 30% is a cause for concern. This points to technological and structural limitations of the industry. Any vision for the industry must necessarily address this. Increase in domestic market share has therefore to be a primary mission for the industry. Hence the Mission for the industry could be set down as below:

### **MISSION**

- **Secure a domestic market share of 50% in five years and 67% by 2020;**
- **Become one among the top 10 machine tool producing nations of the world**
- **Raise exports to a significant level of at least 20%**

The above Vision and Mission statements for the industry must be viewed as interlinked efforts which will raise the machine tool industry by several quanta to become an important global player. Anything less could actually result in a gradual erosion of the industry to an insignificant place both nationally and globally. This would seriously affect the growth and competitiveness of the Indian manufacturing industry, its competitiveness and even national security.

### 3 Snapshot of the Indian machine tool industry

#### 1. Industry composition:

The Indian machine tool industry is a widely dispersed industry comprising units of various sizes. The industry has an estimated 750-800 companies in all, producing machine tools, parts, accessories and sub-systems. Of these, around 400 produce complete machine tools of all types and sizes. 25 are large industries and the rest are SMEs. IMTMA has a total membership of 464 companies. Out of these, around 400 are manufacturing units in machine tools and related items.

#### 2. Geographical spread:

The geographical spread of the industry is mainly in the south, west and north. Machine tool manufacture is concentrated in the south, especially in and around Bangalore, and in other parts of Karnataka. Around 50% of the total machine tool industry output comes from the south, and Peenya in Bangalore is recognized as the primary centre of machine tool production in the country. Many large companies such as HMT, Ace group, BFW and several SMEs are situated here. The Central Manufacturing Technology Institute (CMTI) is also situated in Bangalore. Hyderabad also has a good machine tool industry, producing both standard and special purpose machines.

Pune has a strong machine tool industry, and the units here have specialized in several niche technologies such as electro-discharge machining, automation and robotics, measurement technology and machine tool related electronics. Pune also hosts a large unit producing metal forming machines. The presence of a large automobile industry in Pune has spurred the development of the machine tool industry in this city.

In the west, Rajkot and Bhavnagar are important centres of machine tool production. A few large units and a large number of SMEs produce both advanced CNC machine tools and the conventional manually operated general purpose machine tools. The industry in this region also exports machine tools, especially conventional machines.

In the north the industry is located in Ghaziabad, Jullundhar, Batala and Ludhiana. Ghaziabad has modern units producing high tech machines but the rest are relatively old units and produce conventional machine tools. These machine tool companies are family owned and smaller in size compared to units in the south.

The population of IMTMA member units is roughly as follows: South: 151, West: 196, North: 111, East: 6. This largely reflects the population distribution of the entire industry of approx. 800 units region wise.

#### 3. Employment:

The machine tool industry is estimated to employ around 30,000 persons. Although small in comparison with many other industries, the skill levels of the industry are highly specialized and are acquired mostly through in-house training within the machine tool units. Of late the industry has developed the sub-contract or "outsourced" model of production, whereby the main units produce machine tools but not all the components. The components and sub-assemblies are sourced from smaller units. The main units concentrate on the final assembly, design, engineering, quality and application aspects of the machine tools. This has resulted in the industry taking in more diploma level persons and engineers for the higher technical functions.

There is a dearth of qualified and skilled entrants to the industry due to the growth of the IT industry and the attraction it holds for new entrants to the employment market. The machine tool industry is thus handicapped in finding suitable entry-level manpower to take up the higher technology activities in the industry.



#### **4. Technology and products:**

The Indian machine tool industry has developed through a mix of collaborations, joint ventures and its own development efforts at different periods. At present, the industry has a good design and development capability and is able to develop most machines in the mid-level applications. The machines produced by the industry are predominantly of its own design. There are virtually no product/technology collaborations although a few joint ventures with Indian investments have come up in some areas. A large number of foreign companies have opened marketing offices/tech centres and a few have also set up manufacturing operations.

The result of this is that Indian machine tool companies meet the medium applications, while the high end machines are mostly imported. This has resulted in the market share for Indian manufacturers shrinking to around 30-35%.

Indian companies have a wide range of products such as conventional machines, CNC machines, some specialized technologies/products and a limited production of large machines and metal forming machinery. This is more fully described in Sec.4. Technology and product gaps are areas of concern for the industry. Measures to bridge these have to be taken urgently to make the industry able to meet foreign competition.

#### **5. Industry data:**

The figure (page 17) gives a graphical representation of the industry's performance over the last 20 years. It can be seen that the industry has passed through a recessionary period around 2000, but recorded high growth in its output after 2003. This is due to the rapid growth of the automobile industry in India and the emergence of a strong auto component industry, which has been the mainstay of the industry in recent years. The downturn of 2008 and 2009 affected the industry badly but the industry is on a recovery path in 2010-11 thanks to the recovery in the auto industry.

The graph also brings out the steep increase in imports to meet the large demand from users in recent years, resulting in a fall in market share for the Indian machine tool industry. It is this trend which needs to be addressed by the industry by developing new technologies and products to meet the anticipated requirements of the user industries in the future.

#### **6. Imports:**

Perhaps the most important development in the last decade is the rapid increase in the import of machine tools. This is the result of the rapid expansion of the automobile industry and the investments that have taken place in component manufacture. The Indian machine tool industry has lost domestic market share from around 70% in the year 2000 to around 30% in 2010. Imports have been strong in certain product lines such as grinding, gear cutting, metal forming and large machines where the Indian machine tool industry is weak. There has also been import in product lines like CNC turning centres and machining centres where the domestic manufacturers have limited capacity to meet the sudden surge in demand.

Used machine imports have constituted around 10-15% of total imports, and are again mostly in product lines where domestic production is weak.

#### **7. Exports:**

As can be seen from the data presented, exports of machine tools from India are not significant. This is due to the large domestic market which absorbs almost the entire production. The lack of volume production on global scales makes Indian machines non competitive against countries like Taiwan, Korea and lately China in standard products. Many companies have tried to have export presence in markets in Europe and USA. Most have eventually withdrawn due to the high cost of marketing and

market presence in these countries. Technology gaps have also played a role in making Indian machines unattractive to foreign buyers although in some cases prices have been competitive.

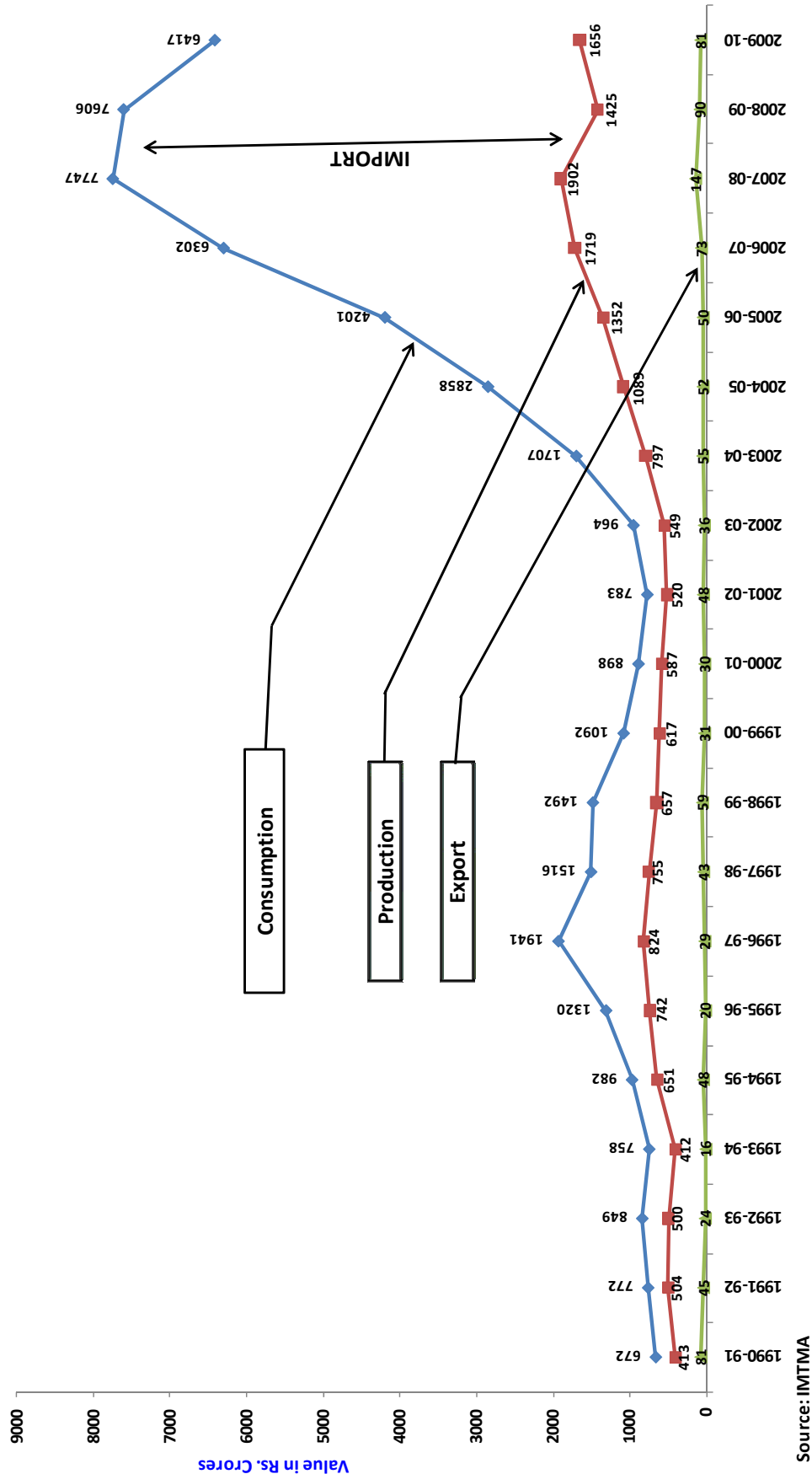
Of late, some Indian machine tool companies with niche/technology products (edm, grinding, cnc turning, automation etc.) have re-entered the export markets by setting up subsidiaries and marketing offices abroad.

Another encouraging trend is that Indian machine tool companies have even acquired machine tool companies in France, Canada and other countries. The strategy is to acquire companies complementing their Indian products and so extend their market reach both in India and abroad. These efforts appear to be successful, but need to be watched to see their sustainability over the long term.

#### **8. Future outlook:**

The future outlook for the industry is optimistic. The estimates presented in Sec.4 show that the machine tool industry can expect a continued growth in demand. An aggregate demand of Rs.60,000 to Rs.70,000 crores is anticipated over the next five years. If the industry can overcome its constraints in technology and products to meet the high end requirements and reach a market share of at least 50%, the future of the industry can indeed be bright. This is also essential to meet technology denial from advanced countries which compromise national security.

### Consumption, Production and Export Trend from 1990-2010



## 4 Machine Tool Demand Projections

The requirements of machine tools in the next five to ten years are derived from the anticipated expansion and growth plans of the major user sectors and the technological advancements in machine tools and manufacturing technology. The major user sectors for machine tools are:

- a. Automobile (both OEMs and auto component manufacturers)
- b. Power equipment and rotating machinery (turbines/generators/motors) industries
- c. Railways and heavy transportation
- d. Consumer durables
- e. General industrial machinery
- f. Defence, aerospace and atomic energy manufacture (strategic sector)

An estimate of the gross machine tool requirement for each of these sectors is made on available information on their expansion and growth plans:

1. **Automobile sector:** The Automotive Mission Plan 2006-2016 has estimated an investment of Rs.160,000-180,000 cr during this period, to meet the stated objectives of the plan. These are gross project investments in plant, machinery and facilities. The investment on machinery is expected to be around 25% of the total investment. On this basis, the investment on machinery will be around Rs.40,000 cr. It may be taken that the investment in machine tools, both from auto majors and the component industry, may be estimated at around Rs.20,000 cr, the remaining going to other factory equipment. An ACMA/McKinsey report has also mentioned an FDI target of USD 5 billion over the next five years to raise the auto component industry. This translates to a likely machine tool consumption of around Rs. 15,000 cr from the auto component industry alone.

From the foregoing, it may be safely taken that the auto industry will consume around Rs. 3000 cr/year of machine tools for the next five years. This may increase further as Indian auto production touches higher levels as India becomes a major auto hub.

2. **Power equipment:** BHEL, the largest producer of power equipment in the country, has forecast a machine tool requirement of Rs. 5000 Cr over the next five years, to raise their capacity to 30,000 MW annually. Assuming that other companies in the sector proportionally increase their production capacities to meet demand, the demand for machine tools is likely to be around Rs. 7000 Cr. from this sector.
3. **Process industry:** India has a fast growing process industry in gas, fertilizer, chemical and petroleum. The likely demand for plant equipment and machinery is Rs.10000 – 15000 cr over the next few years. Of this, around 20% may be taken as machine tool requirements to machine the various components of process plants. This would translate into a demand of Rs. 2000 to 2500 cr.
4. **Railways:** The modernization of existing Railway Workshops and setting up new capacities in locomotives and rolling stock is expected to generate an investment of Rs.2500 cr in machinery over the next five years. These are for standard and special machines required by the railways.
5. **Consumer durables:** The demand for machine tools from this sector is mostly for metal forming machinery and plastics processing machines. To a large extent these are met through imports, and this sector represents a field for generating substantial demand for domestic machine tool manufacturers.

**6. Industrial machinery:** India has a vibrant manufacture of industrial machinery such as gearboxes, textile machinery, printing and packaging machines, pharmaceutical machines, food processing machinery etc. Machines comprise metal cutting, metal forming, plastics processing and special machines. The Die/Mould industry is one of the fastest growing industries in India, spurred by the rapid expansion of consumer durables, plastics goods and technical plastics in a wide variety of industries such as auto, electronics, instrumentation, medical etc. Together, these industries consume around 20% of total machine tool consumption in the country.

**7. Defence and aerospace:** These sectors form one of the most important, and large consumers of machine tools. Requirements range from standard CNC machines to large machines, multi-axes machines and special machines to meet the stringent requirements of these industries in terms of materials processed, complications and size of parts, and high accuracy demands. These sectors import much of their requirements but it is essential to point out that these sectors are subject to technology denials from advanced countries and this has caused delays and reworking of machinery in several cases. These sectors also source machine tools from Indian manufacturers.

The demand for machine tools from the aerospace and defence sectors has been estimated at Rs.2750 cr over the next five years. This is only from the government sector. There is a strong private sector developing in aerospace component manufacture, mainly for export and as a result of offset trade on large government purchases. These are expected to generate an additional demand of at least Rs.1000 cr of machine tools.

**8. Atomic energy:** This sector has a large requirement of highly specialized equipment for the atomic plants and R&D establishments. In general, the machine tools required for processing these components are very large machine tools which are imported. There is no direct requirement of machine tools by DAE except in limited number by BARC's Central Workshops. However, suppliers of equipment to DAE/NPCL generate some demand for large and specialized machine tools. However, these are limited, as such facilities already exist in India and serve the DAE as well as the process industry in India.

#### **Demand projections for machine tools:**

Based on the information available from these sources, the demand for machine tools (consumption) over the next five years may be estimated as follows (Rs. Cr):

Automobile and auto components	15,000
Power equipment and rotating machinery	7,000
Railways and heavy transportation	2,500
Consumer durables + General industrial machinery	10,000
Defence, aerospace and Atomic Energy (strategic sectors)	6,000
Others: (Valves, pumps, compressors, electronics etc)	10,500
<b>Total estimated demand over 5 years</b>	<b>51,000</b>

#### **Demand projection based on historic trends (see figure on p. 22):**

The demand for machine tools can be estimated from the actual consumption of the last 10 years, which have seen both periods of high growth and low/negative growth. The trend of consumption is shown in the graph below, based on the consumption figures from 2000-01 onwards. The data has been projected based on reported figures for consumption and production, ***adjusted upwards by 50% to take into account domestic production outside IMTMA figures.***



- a) **Demand:** Based on the (adjusted) figures from 2000-01 to 2009-10, the consumption trend for the projected period from 2010 to 2020 shows a linear growth rate of 10%. However, this rate is very low, considering that in recent years consumption has grown at 30-35%. Also, the national target for manufacturing sector growth is at least 12%. It is therefore more realistic to assume that machine tool demand will grow **at least** at 15% CAGR hereafter. This growth trend is shown in dotted line along with the expected demand figures for 2014-15 and 2019-20 (5 and 10 years from now).
- b) **Production:** The trend line based on the (adjusted) production figures show a CAGR of around 10% for the next ten years. This is too low, and is evidently the result of the down-turn in the last two years which have affected the industry's continued upward growth witnessed in the previous few years, which have been as high as 30%. A CAGR of 15% or even 20% can be taken as a realistic and possible performance of the industry over the next decade. The growth trend on a 20% CAGR is shown in blue color in the graph (Demand Projection & Growth Path) on page 22.
- c) **Projections:** Based on the above, the projected demand and production figures for machine tools are summarized in the table below at compound annual growth rates of 15% for demand growth and at 20% and 25% CAGR for production growth:

(Rs. Crores)

	2009-10	2014-15	2019-2020	Remarks
<b>With production growth at 20% CAGR:</b>				
Demand	7289	14560	29286	Demand growing @ 15% CAGR
Production	2478	6166	15343	
Export	-----	-----	-----	
Market share	33%	42%	52%	Market share at 50% even without exports
<b>With production growth @ 25% CAGR:</b>				
Demand	7289	14560	29286	Demand growing @ 15% CAGR
Production	2478	7562	23078	
Export	-----	-----	4615	20% export in 2019-20
Market share	33%	50%	65%	Market share 65% with 20% export 2019-20

It can be seen that the **industry must grow at a CAGR of 25%** from now until 2020 to meet the targets set down in the Mission statement above. This is especially so for attaining a significant export of 20% of production while attaining a domestic market share of 67% by 2020, both of which are realized if the growth rate of 25% can be attained. These figures can be considered as the projected size of the Indian machine tool industry in 2015 and 2020. On this basis the yearly demand and production for the next five years is projected as follows:

(Rs. Crores)

Year	Demand	Production (25% CAGR)
2010-11	8382	3100
2011-12	9639	3870
2012-13	11085	4840
2013-14	12748	6050
2014-15	14660	7560
Total	56514	25420

The economic climate in India is expected to be quite positive over the next five to ten years. In the absence of any events internal or external seriously destabilizing this situation, the manufacturing sector growth can be expected to be robust. This will spur machine tool demand, and the assumed 15% compound annual growth rate may well be exceeded. In such a case the demand for machine tools will be greater than the projections worked out above.

From the foregoing, **an aggregate demand** of around **Rs.60000 – 70000 cr.** may be taken as indicative of machine tool demand (consumption) over the next five years. The Indian machine tool industry will be hard pressed to respond to this demand and to hold its place in the market. The realization of the anticipated production volumes for this industry will require the focused implementation of various measures and recommendations given in this report.

**d) Demand and production projections to 2019-20:**

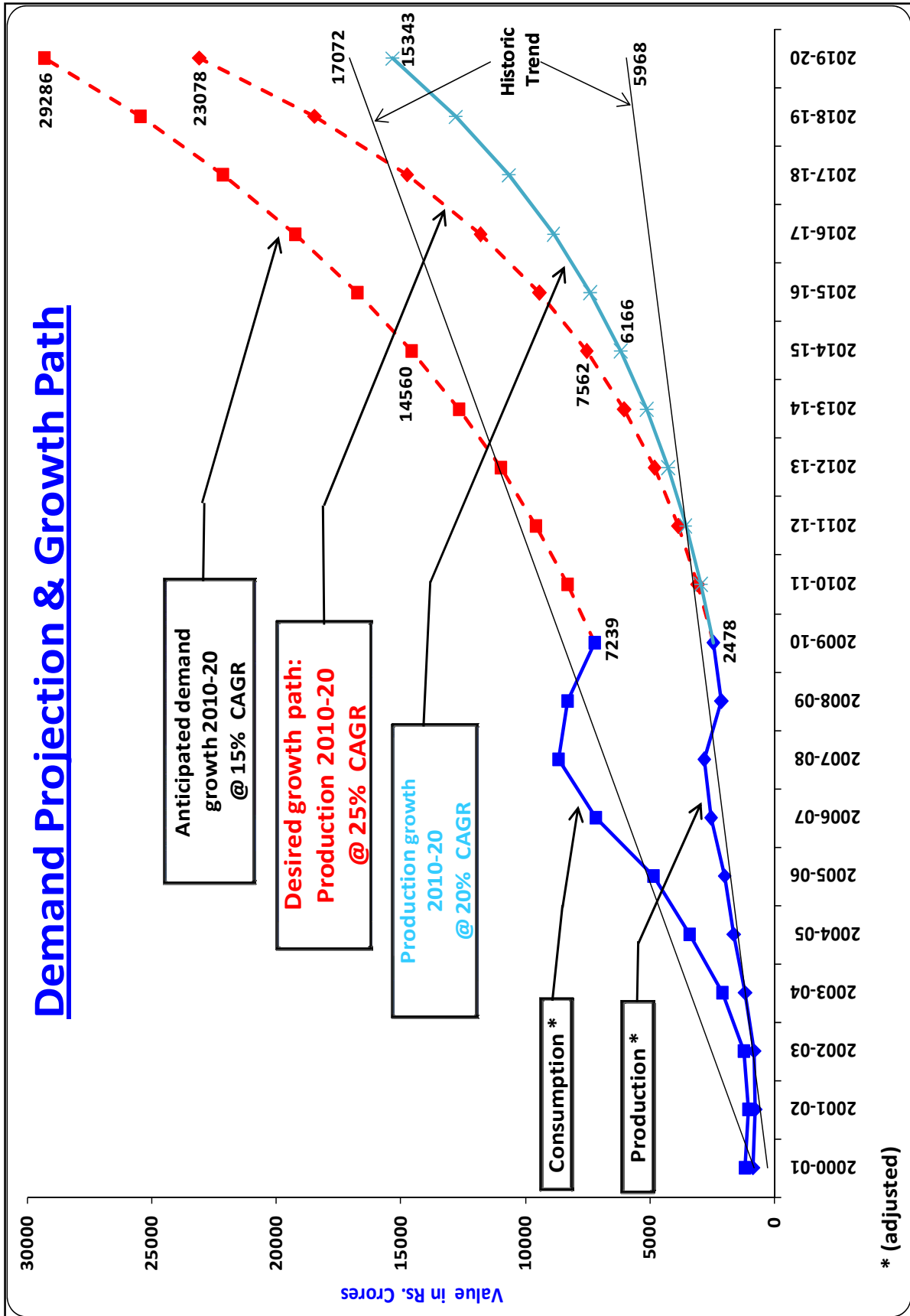
Based on the anticipated demand growth rate of 15% CAGR and desired production growth rate of 25% CAGR the figures for the period from 2015-16 to 2019-20 work out as below:

(Rs. Crores)

Year	Demand	Production (25% CAGR)
2015-16	16860	9450
2016-17	19390	11812
2017-18	22300	14765
2018-19	25640	18457
2019-20	29300	23080
<b>Total</b>	<b>113490</b>	<b>77564</b>

These figures may be taken as an indication of the demand for machine tools for the purpose of working out suitable strategies for the industry to upgrade, invest and ramp up its production in the long run.

## Demand Projection & Growth Path



## 5 Technology expectations, gaps and R&D

The demand for machine tools is undergoing a rapid change in tune with the requirements of user industries. The global aspirations of our industries as opposed to a domestic orientation in the past has led to the adoption of the latest technologies in manufacture and machine tools, to meet quality and productivity demands. Thus Indian auto component industries have adopted latest manufacturing technology, and succeeded in becoming the lowest cost manufacturers in 2-wheelers, and are becoming the most cost effective manufacturing destination for compact cars, even competing with china in the process.

There are also new manufacturing sectors which have come up in India, among which the aerospace manufacture is the most noteworthy. Hence the technological upgradation and product development of machine tool industry in India must be structured to meet the present and future demands of the user sectors. The major technology demands may be set forth as below:

1. **Multi-axes machining centres:** These are required to meet the manufacture of components for the aerospace and to some extent the auto and rotating machinery sectors. Typically, the machines will have the ability to machine in 5 axes with simultaneous interpolation, high speed spindles, and high precision. Such machines are mostly imported. Except for limited development carried out by some Indian manufacturers, there is no commercial production of these machines.

These machines also come under technology denial regimes frequently. So there is paramount urgency in developing the technology of these machines on top priority, to reduce our dependence on imports and the associated risks.

2. **Multi-tasking machines:** The trend towards multi-tasking machines has shown strong development abroad, especially in those industries manufacturing components of high complexity, large size and high accuracy in batch production. Typically, such applications are in the power equipment (BHEL), aerospace, valves, process industry components etc. Typical multi-tasking machines are Mill-turn centres, Machining centres with turning capability, Vertical Turning Machines with machining and milling capability etc. Such machine tools do not have high demand but for certain applications are eminently suitable in maintaining accuracies, improving productivity, reducing fixturing and handling. Such machines reduce lead-time for special components to the minimum.

3. **High precision machines:** The average tolerance band for components which was 5 microns a decade ago has shrunk to 1-2 microns today. The machine tools are required to deliver high precision in regular production environment, with high process capability index. High precision machines are required to be developed in turning, machining centre and grinding primarily, but the technology is applicable to practically every machine tool type including special purpose machines.

Development of high precision machines calls for new materials, high static and dynamic design properties, effective thermal balance and precision in component manufacture and assembly. It requires concerted R&D efforts of individual companies along with institutions like CMTI, IITs etc.

4. **Large machine tools:** The rapid growth of the energy, power (BHEL), process and atomic energy industries, Railways and Defence and the nascent wind-mill industry has spurred the demand for large machines such as floor boring machines, large gantry machining centres, vertical turning machines etc. A limited capacity for the manufacture of such machines exists in Indian companies but the machines lack the latest features and technologies like hydrostatic bearings and slideways, error compensation etc. which makes the machines accurate and productive.

Italy and Spain have specialized in the manufacture of such machines and almost all such machines imported into India come from these countries. A Spanish manufacturer of large boring machines is establishing a facility in Pune to cater to Indian demand.

- 5. Gear cutting and grinding machines:** Indian machine tool technology is lagging by around 10 years in these two critical areas, which are the mainstay of the automobile component industry. Only two companies (HMT and Premier) produce gear cutting machines, and similarly only two companies (HMT and MGTL) produce grinding machines in any quantity in India. There is a large import of these machines, both new and used machines.

Gear cutting technology has become highly productive, with high cutting rates and dry cutting being the dominant features. Grinding machines offer high accuracy and grinding with CBN and super-abrasives. Both gear cutting and grinding have developed very high productivity through the application of latest technologies. Indian manufacturers lack the ability to compete and usually meet the less demanding applications from users. Development of the latest technology in these areas will require intense R&D.

- 6. Electrical and micro-machining:** Electrical machining technologies such as electro-discharge machines (edm), wire-edm, electrochemical machines play a vital role in high precision and fine engineering in industries such as die and mould, defence, instrumentation, medical, optical, electronics, toys industries besides others. These are the backbone to the tool making industries and are critical to many component manufacture in the sub-millimetre dimension, often going down to micron level (hence the name “micro-machining”). In India one company alone specializes in edm technology, and has met user requirements fairly well. However the higher levels of technology are met through imports from Europe and Japan. Advances include higher metal removal rates, ability to control surface finish and texture, micron level dimensional accuracy, complicated profile generation etc. R&D efforts need to address these areas.

- 7. Metal forming machines:** Indian manufacture of metal forming machines is limited to presses and sheet bending machines, largely. There is very little manufacture of modern sheet working machines such as punch/turret punch presses, transfer presses, fine blanking, cold/hot headers, forging machines, form rolling machines etc. Die casting machines, an important component of metal forming machines, is produced in limited quantities in India. Imports dominate in this as well, thanks to advanced technologies in process control. It must be mentioned that Indian industry has developed the latest servo press technology and hydroforming technology. However, these have yet to take strong market roots among users in India. Overall, as compared to metal cutting machine tools, Indian metal forming machines are relatively less advanced.

A study commissioned by IMTMA has estimated the demand for metal forming machines to reach Rs.8900 cr by 2014-15, growing at an annual rate of 21% in the next five years. Metal forming machines are expected to constitute nearly 50% of total machine tool demand by that time.

It is clear from the foregoing that the industry needs to give special attention to R&D and product development in the future if it is to hold its position as a supplier of consequence in India. The focus will have to be developing the following metal forming technologies:

- Higher press automation and transfer systems,
- Servo presses,
- Sheet working machines (including laser, waterjet heads)
- Hydroforming,
- Fine blanking
- Forging machines.
- Flow forming

Specialized technologies such as

- Explosive forming,
- Electro-magnetic forming etc.
- Cutting tool technologies
- Robotics and automation
- Alternative materials (epoxy granite etc.)
- Thermally stable welded structures
- Hydrostatic spindles, guideways
- Motorised and high frequency spindles
- Smart machines with embedded sensors

These are particularly important for the strategic sector for the production of armament, missiles, rockets and the like. These technologies also have application in auto component and other industries.

**8. Critical components for CNC machine tools:** The Indian machine tool industry suffers from a serious limitation which could prove a major weakness in future. The industry depends entirely on imports for all the critical components it needs to build CNC machines. These are:

- Anti-friction linear guideways
- Ball screws
- Precision spindle and ball screw support bearings
- CNC controls
- Spindle and axes servo motors with drive controllers
- Feedback measurement systems

These form the “heart” or “core” of all CNC machine tools and may be compared with the microprocessor and memory chips in a computer. This import dependence is because these items are of high technology and require heavy investment to develop their technology and manufacture. In the case of CNC, motors and drive controllers, these are essentially electronic systems of high sophistication and are the virtual monopoly of two companies in the world which have developed them over decades of R&D. India imports all these critical items largely from sources in Japan and Germany, just as other machine tool manufacturers do all over the world.

The danger in this dependence is that these items may be subject to export control as “dual use” technologies. There have been several instances where these items have been denied to Indian machine tool manufacturers when the machines are destined for the strategic sectors. So it is in India’s ***manufacturing competitiveness and national security*** interest to invest the time, resources and effort to develop these critical components to make the machine tool industry relatively immune to denial regimes.



**9. Machine tool attributes:** Modern machine tools are characterized by high reliability, flexibility and quick change capabilities to meet diverse production needs. Concepts of material and energy efficiency, environmental standards, life-cycle costs, end-of-life recycling etc. are being applied to machine tools, especially in Europe and other advanced nations. While developing new technologies/products, the Indian machine tool industry will have to respond to these challenges.

**10. A summary of existing and the important technologies which need development is given below:**

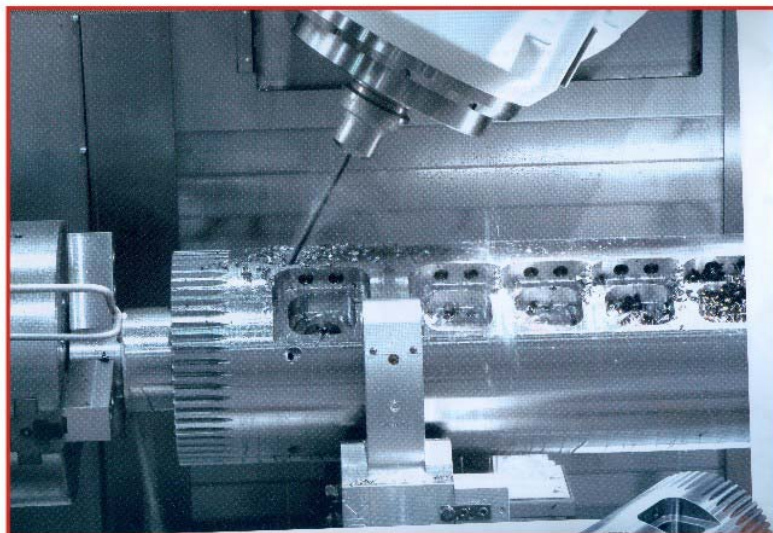
Existing Technology	5 Year Development perspective
<p><b>Existing:</b></p> <ul style="list-style-type: none"> <li>➤ Non CNC general purpose machines</li> <li>➤ Standard CNC machines</li> <li>➤ Gear cutting, Grinding</li> <li>➤ Medium sized machines</li> <li>➤ EDM, Wire-EDM</li> <li>➤ SPMs</li> <li>➤ Medium size machines</li> <li>➤ Presses, Press Brakes</li> <li>➤ Pipe Bending</li> <li>➤ Hydroforming (ltd)</li> <li>➤ Servo presses (ltd)</li> <li>➤ Rolling, Bending</li> <li>➤ Measuring, metrology and gaging</li> <li>➤ Drives and controllers (limited)</li> <li>➤ Sub-systems (ATC, Rotary tables, tool turrets, chucks, tooling etc.)</li> </ul>	<p><b>To be developed:</b></p> <p><b><u>Metal cutting machine tools:</u></b></p> <ul style="list-style-type: none"> <li>➤ Multi-axes, Multi-tasking machines</li> <li>➤ High precision machines</li> <li>➤ Large machines (boring-milling, turning)</li> <li>➤ Gear cutting and finishing machines</li> <li>➤ Grinding technology and machines</li> <li>➤ Electrical and micro-machining</li> </ul> <p><b><u>Metal forming machines:</u></b></p> <ul style="list-style-type: none"> <li>➤ Higher press automation and transfer systems,</li> <li>➤ Servo presses,</li> <li>➤ Sheet working machines (including laser, waterjet heads)</li> <li>➤ Hydroforming,</li> <li>➤ Fine blanking</li> <li>➤ Forging machines.</li> <li>➤ Flow forming</li> </ul> <p><b><u>Special technologies:</u></b></p> <ul style="list-style-type: none"> <li>➤ Explosive forming,</li> <li>➤ Electro-magnetic forming etc.</li> <li>➤ Cutting tool technologies</li> <li>➤ Robotics and automation</li> <li>➤ Alternative materials (epoxy granite etc.)</li> <li>➤ Thermally stable welded structures</li> <li>➤ Hydrostatic spindles, guideways</li> <li>➤ Motorized and high frequency spindles</li> <li>➤ Smart machines with embedded sensors</li> </ul> <p><b><u>Critical components development:</u></b></p> <ul style="list-style-type: none"> <li>➤ Anti-friction linear guideways</li> <li>➤ Ball screws</li> <li>➤ Precision spindle and ball screw support bearings</li> <li>➤ CNC controls</li> <li>➤ Spindle and axes servo motors with drive controllers</li> <li>➤ Feedback measurement systems</li> </ul>



**Typical large boring & milling machine  
For machining energy sector components**



**Typical 5 axis Machining Centre**



**Typical Multi function machine**

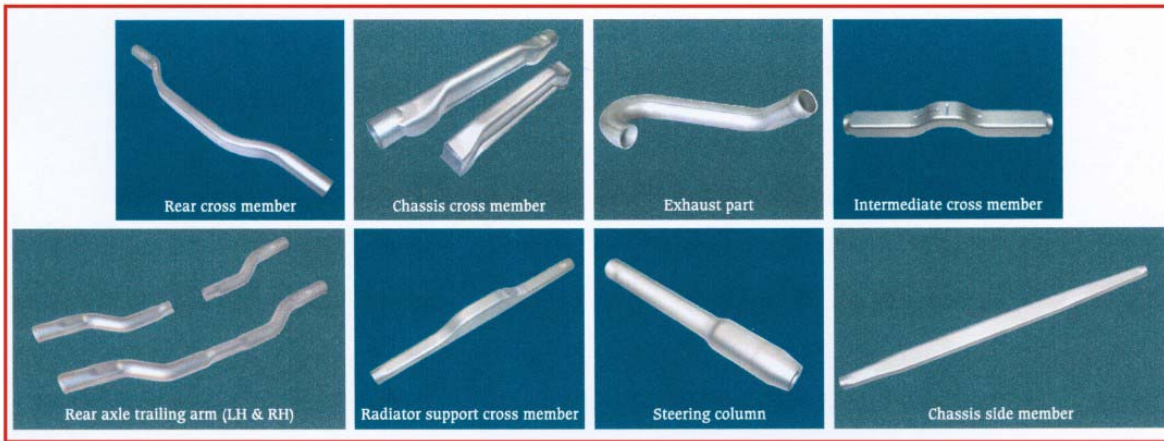


**Large SPM for machining cylinder block built by Indian Machine Tool Company**



**Large cylinder block for railways**





## Hydro Forming Technology developed by Indian Company



**Flow forming technology, critical for aerospace industry,  
Subject of continued technology denial**

**A strategy for the development of these technologies is recommended below:**

**a. Constitute a Machine Tool Technology Committee** with representation from:

- i. DHI,
- ii. Major users
- iii. NMCC
- iv. PSA's Office
- v. MoST (DSIR/DST/TDB)
- vi. IMTMA
- vii. Machine tool companies
- viii. CMTI
- ix. Select academic institutions
- x. Planning Commission
- xi. Ministry of Finance
- xii. Others as decided by the DHI

This committee must be empowered to plan, steer and monitor the entire R&D and technology development program for machine tools. It must also be responsible for coordinating the availability and release of funding for the program, and for the commercialization of the technologies/products developed. The possibility of enlarging the mandate given to the **Programme Advisory Committee for R&D in Machine Tools** constituted by the Office of the PSA to Govt. of India to oversee the technology development of the machine tool industry along the lines given here may be examined. The Office Memo of the PAC is given in Annexure 3. This PAC has representation of DHI and MSME. The mandate of the PAC is to identify technology gaps and promote R&D activities jointly with industry, academia and R&D institutions to fill these gaps. Several projects are being formulated by the PAC, broadly in line with the gaps identified in this report.

- b. Draw up detailed R&D project proposals.** While doing so, the group should identify the end users, the development agencies and the company/agency which will commercially manufacture the end product, whether machine tool or its component. The project proposal should address the development phase, specialist inputs required whether from India or abroad, commercial prototype/pilot batch production, commercial producer, investments required and the means to ensure continued R&D to keep such advanced developments constantly updated.
- c. Consider the marketing aspects.** New technologies/products need marketing, both in India and abroad. It is often the case that development is successful but subsequent marketing efforts are insufficient to make commercial success of the products.
- d. Constitute a separate funding mechanism.** This will exclusively finance the development of machine tool technology as a strategic measure for the country. The representation of the Planning Commission and the Ministry of Finance on the committee suggested would be responsible for this aspect.

The funding scheme for the development programs may broadly follow the existing pattern of development funding made available by DSIR, DST, TDB and other government agencies. These are largely in the form of development funds which are advanced to implementing companies and are then repaid by the companies after successful commercialization of the

technologies/products. This way the government will only act as a catalyst in the development effort, recouping the initial costs subsequently.

- e. **Select the machine tool companies.** Those participating in the development program may be selected based on their present product/technology portfolio, manufacturing capacities and should be companies which will offer the best chances of making a commercial success of the R&D outputs.
- f. **Strengthen CMTI:** The Central Manufacturing Technology Institute (CMTI) is the only R&D institution with a long background and competence in machine tools and manufacturing technology. It is equipped with the basic facilities and infrastructure to take up the development of new machine tools and technologies, and to support machine tool companies in their development activities with specialist inputs in design, analysis and testing. CMTI also has good manufacturing facilities for precision manufacture of components. It is equipped with the Precision Engineering Centre, which offers very high precision machining and measurement, the only facility of its kind in this part of the world. With this infrastructure, CMTI can play a pivotal role in the R&D programs for the machine tool industry.

The first step in strengthening CMTI has already been taken. **The Advanced Machine Tool Testing Facility (AMTTF) is being set up as a government-machine tool industry project at CMTI** to develop the latest facilities and equipment to test machine tools to modern standards, thereby substantially augmenting the existing facilities. This project is being jointly established through a grant from DIPP and contribution from the machine tool industry.

It is very necessary to strengthen CMTI further and draw on its resources in the R&D projects and programs given in this report. CMTI should play an anchoring role in the entire effort. An outlay of Rs. 400 cr. may be made for the further development of CMTI into a world class R&D institution. In view of the large development effort foreseen, it will be necessary to create 2 or 3 more R&D centres in west and north India to support technology development, modernization and product development in the machine tool industries in these regions. These may be on a smaller scale than CMTI at Bangalore which will continue to play the major role.

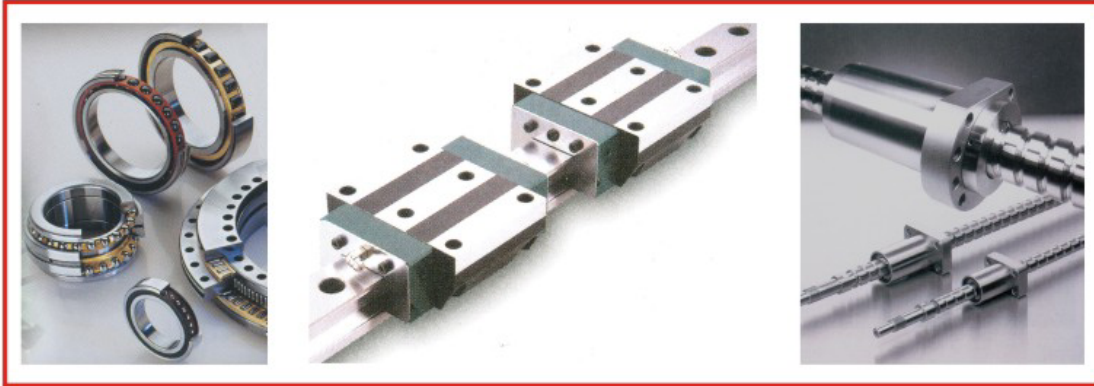
It may be mentioned that the Fraunhofer Institutes in Germany institutions dedicated to Production Technology research and development. China is reported to have more than a dozen R&D centres in the field of machine tools and manufacturing technology. These support the declared targets and objectives of China in the field of machine tools. (Pl see sec. 14 of this report for details). Given its large and expanding manufacturing industry, India has space for at least 5-10 R&D institutions in machine tools and manufacturing technology. These may be autonomous R&D institutions like CMTI, and R&D centres located in the IITs by suitably expanding the facilities and resources at these institutions. This will require substantial funding and expert staffing.

- g. **Critical components of machine tools and CNC/Machine Tool Electronics:** These areas represent major technology gaps which must be addressed on priority. The technologies are advanced, complex and need investment to take them to the commercial phase. It is therefore very necessary that commercially interested companies be involved in their development from the beginning.

It is recommended that the p-p-p company route be adopted in these areas. The government, interested machine tool/electronic/other companies and R&D/technology developers may form p-p-p venture which will take up the development, commercial production and marketing of



these technologies and products as commercial ventures. Government will be required to fund the entire development phase costs; subsequently, this venture may pay a royalty to the government from commercial proceeds to pay back, even if partially, the development phase costs. The p-p-p companies will have to be structured as autonomous board managed commercial entities from the beginning. Technology sourcing from global companies is desirable, if available.

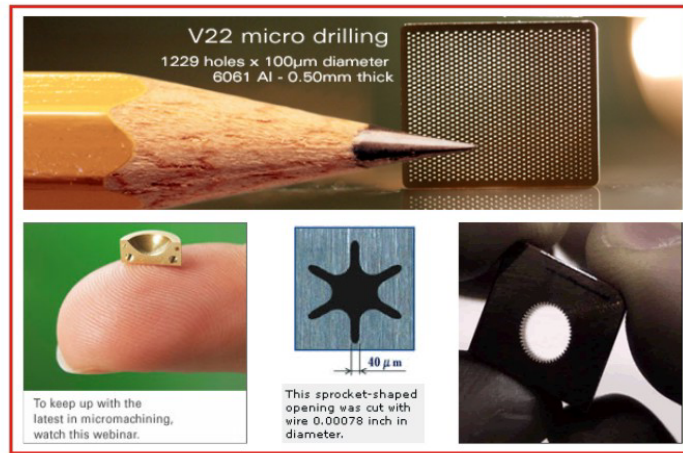


### **Critical mechanical components for CNC machines Spindle bearings, Linear Bearing, Ball Screws**

- h. Development contracts:** In all advanced countries new technologies in any scientific/engineering field are done through a “Development Contract” between the purchaser and a manufacturer, the risks being shared by both. Examples in the defence, aerospace fields are very common, while it is also used in machine tool and manufacturing technology development. For example, the NSF in the US funded the development of the latest “Hexapod” machine tool by the Ingersoll Company, the University of Michigan receives similar development support for the latest “Reconfigurable Machine tools”. It is recommended that large Indian buyers especially from government/PSU as well as private companies may give “development contracts” to machine tool companies to meet their requirement of advanced machine tools and manufacturing technology.

It is recognized that this cannot be applied across the board. This route may be adopted for long term requirements and 30% of such requirements could be sourced through this route. This concept of a risk sharing development contract will give a major thrust to R&D and technology development in Indian machine tool companies. The government could also provide concessions to those industries that promote technology development in machine tools by investing in machine tool R&D efforts.

***This concept is not new and has been very successfully adopted by DAE and ISRO in developing their specialized requirement of equipment and facilities.*** A detailed note on *Development Contract as a route to Technology Development* is given in Annexure 7.



## Typical Micro – Machined Components for Instrumentation, Medical, Aero-space and Auto Industries

### 11. Financial outlay on the development of new technologies listed:

It is difficult to make a reasonably accurate estimate of the financial resources that would be required to develop the technologies and products listed. It must be appreciated that each of these is an area of high specialization by individual companies which have invested in developing and perfecting their technologies and products over several decades. Nevertheless, it is possible to develop these indigenously provided a mission-like approach is taken and the required resources: financial, expert manpower and physical are made available.

One way of estimating the cost of development of these technologies/products is to assume that each will incur a development cost of 3-4 times the price of a corresponding machine. Several types of machines may have to be developed under each head. On that basis, by obtaining price information for individual technologies/products, the R&D outlay may be estimated.

This does not apply to the development of Machine tool electronics (CNC, drives, motors and measuring system). These are very complex products and will require a multi-organization cooperation to develop. Similarly, the development of critical mechanical elements will require far more resources.

At a very rough estimate, the total R&D outlay may be as follows:

Technology/product	R&D cost, Rs crores
• Technologies leading to products	1000
• Critical mechanical elements *	300
• Machine Tool Electronics (CNC etc.)*	300
• Strengthening CMTI	400
• Total	2000
*includes production facilities for manufacture	

(These estimates have to be worked in detail by separate groups constituted for the purpose)

## 6 Fiscal and policy measures to support the machine tool industry

In a Roadmap for the industry presented to the industry ministry, NMCC and the Planning Commission in February, IMTMA had identified the immediate and short term measures required to support the industry. The Roadmap document is reproduced in Annexure 4.

Among the various measures enumerated in the Roadmap document, the following fiscal measures may receive immediate attention of the DHI and Government of India:

### **Fiscal measures:**

- a. Reduce customs duty on** all critical elements not manufactured in India to Zero: The Customs duty applicable on import of all machine tools at present is 7.5%. Critical components for CNC machines which are not produced in the country like CNC Systems, Ball screws, Spindle, High Precision Bearing, in process gauging equipment, Servo Drive etc. also attract a customs duty of 7.5%. These elements account for approximately 30-35% of the input cost. The industry has to pay higher prices for these inputs due to lower volumes of purchases and secondly has to pay an import duty of 7.5%. Both these elements increase the cost of machines in India.

Furthermore, small scale manufacturers have to pay Countervailing duty of 10% on all imports of inputs which they cannot modvat as they are not covered by Excise duty. This inhibits the growth of technology in small sector. This anomaly has to be corrected to reduce the cost of CNC machines produced in the country and make them more affordable to SMEs and to counter imports.

In order to remedy the situation it is suggested to reduce custom duty on following components of CNC machine tools (which are not manufactured in India) from the existing level of 7.5% to Zero duty, at least until such time as these components are developed and manufactured in India:

- i. CNC Systems covered under tariff head 85.37 ,
  - ii. Servo Drives/Motors covered under tariff head 85.01 or 85.04,
  - iii. Precision Spindles covered under tariff head 846693,
  - iv. Ball Screws covered under tariff head 8483,
  - v. LM Guide ways covered under tariff head 848280,
  - vi. Precision Bearings covered under tariff head 8482,
  - vii. Precision Gauging and Balancing System covered under tariff head 903180 or 9016
- b. Reduce Excise Duty** on machine tools from the present 10% to 8% or even less, these being primary inputs to the manufacturing industry.
- c. Introduce a system of “pass through” MODVAT** which will allow larger units to get credit on excise duty paid on inputs by non-excise units

- d. **SMEs may be given loans on easy interest rates** of say 6% to encourage more of them to adopt the latest machine tools in their manufacturing units
- e. **CLUSS scheme:** MSME ministry offers a CLUSS with a 15% subsidy, but the scheme is limited to designated industries and machines. It is felt that the scheme may be allowed to all SSIs in manufacturing.
- f. **Exempt or reimburse excise duty to small scale manufacturers** and job shops that do not pay excise duty on their terminal products.
- g. **Allow higher rate of depreciation, say 25%** on Indian machine tools so that it encourages the purchase of Indian machine tools and entire cost of the procurement is written off in 4 years. This is desirable in view of rapid technology changes in machine tools. This measure will also build demand for new machine tools from Indian manufacturers, which in turn will attract more investment into the industry.
- h. **Treat machine tools as “priority sector” for financing;** currently treated as “risky sector”. Apply lower interest rates to attract investment.
- i. **Interest rates:** The Indian machine tool industry suffers a major disadvantage on interest rates when compared with foreign manufacturers:
  - a. Interest rate in India: 14-16%
  - b. Interest rate abroad: 2-4%

This in itself adds to the cost of Indian machine tools, making them non-competitive against imports. There are other disadvantages suffered by Indian manufacturers:

- Foreign manufacturers offer deferred LC payments of 1-2 years directly to Indian buyers, in effect extending them financing facilities at zero interest. Indian machine tool companies are at a major disadvantage.
- Foreign suppliers can raise working capital loans at 2-4 % interest against LCs opened on them by Indian buyers. Indian machine tool companies do not get such LCs from buyers, and even raising working capital at 14-16% becomes a problem.

Government may address these difficulties in financing and high interest rates and come up with remedial measures to create competitive conditions for the Indian machine tool builders and also lower the prices of machine tools to the end users. ***(The Finance Ministry is reported to be considering such a request from some PSUs, to treat loans as priority sector lending and to charge lower interest rates to them)***

It is suggested that the positive outcome from these fiscal support measures far outweigh the financial impact since machine tools are at the starting point of a long manufacturing chain; the value addition and benefits to economy are much larger and should more than justify a small reduction in revenues estimated above. Estimates show that there is a 1:10 multiplication in economic benefit between investments in machine tools and the capital goods output; and a further 1:10 multiplier between the capital goods industry and the consumer goods manufactured. Overall, machine tools deliver a 1:100 multiplying effect of economic benefit.

Employment potential of machine tools is also significant. Every machine tool generates direct employment for two persons, and additional indirect employment in support functions. SMEs in manufacturing will receive a major philip by bringing down the cost of machine tools, thereby developing entrepreneurship.

**Estimated financial impact of the above measures if implemented:**

	Measure	Rs. Cr/year	Basis for estimating financial impact
a	Reduce custom duty on critical inputs to Zero	25.00	On Rs.1000 cr of CNC machines production, import of Rs.300 cr @ 7.5 % custom duty
b	Reduce Excise Duty from 10% to 8%	60.00	On production of Rs.3000 cr, 2% ED reduction
c	Pass through MODVAT		Not very significant
d	Soft loans to SMEs for buying machine tools	100.00	Assuming Rs.1500 cr machine tools are bought by SMEs, loan of 70% is Rs.1000 cr. Soft loan @ 6% will mean a subsidy of 16-6=10% or Rs.100 cr.
e	Reimburse/exempt ED to non excise paying units	50.00	Non excise paying units purchases of say Rs.500 cr; 10% ED exemption will be Rs.50 cr
f	Higher depreciation rate at 25% say	180.00	If allowed on new purchases only from a designated start date, Rs. 3000 cr x (25%-7.5%) approx. Rs.510 cr will be benefit; IT @ 35% will be Rs. 180 cr.
g	Treat machine tools as priority sector for lending	--	No direct financial impact
h	Reduce interest rates to make industry competitive against imports	160.00	Total borrowals of around Rs.2000 cr by industry. If interest is reduced from 16 to 8%, financial impact will be Rs.2000 x 8% = Rs.160 cr.
	<b>Total estimated financial impact in a year</b>	<b>575.00</b>	<b>This must be weighed against increased machine tool demand and resulting increase in industrial output, entrepreneur development and employment in SMEs.</b>

**Policy measures:**

- a. **Modify government tender terms** (Railways, DGOF, BHEL, PSUs etc) to offer same terms to Indian machine tool companies as for imports. This is a very important measure that is required to be implemented immediately. On open tenders floated by DGOF/Railways and PSUs, the terms offered to Indian companies are disadvantageous compared to those offered to foreign firms in the following important aspects:
  - i. Foreign suppliers get payment by LC, whereas Indian companies do not. This makes it difficult for our companies to raise working capital to execute the order; in view of high interest rates Indian suppliers should in fact be given advance and progressive payments to create equitable conditions with foreign suppliers.

- ii. Indian machines also have substantial import content. The fixed-price quotation puts Indian companies at considerable risk on the cost of import content. An exchange rate variation clause is required to create level conditions between Indian and foreign suppliers.
- iii. The insistence on “prior supply” in tender purchase terms of BHEL also discourages indigenous suppliers. Insisting on this condition makes participation of Indian firms difficult even if they have the capability to design, build and supply the machines. BHEL may be asked to consider revising the tender terms suitably. The “Development Contract” route may be adopted as an alternative to enable Indian manufacturers to develop and supply machines to government buyers.

A comparison of the tender terms and how they affect domestic manufacturers is given in Annexures 5 & 6. The ministry’s immediate intervention is required to remove these differences and enable Indian machine tool companies to compete on an equal footing.

- g. **Exclude machine tools from FTAs:** Do not include machine tools for concessional duty imports in the FTAs, especially in cases where the other country has a strong machine tool industry (e.g. Europe) or such country does not import machine tools significantly. There is no advantage to India, but it can harm the domestic machine tool industry seriously. This also results in an inverted duty structure which is detrimental to the industry.
- b. **Impose technology transfer and local value addition on imports:** The large government purchases of machine tools (DGOF/Railways/BHEL/Others) are often for several crores. These purchases offer an opportunity for India to get the technology of these machines, provided a condition of technology transfer, minimum local content and participation is imposed on the foreign supplier. This was the practice in the 1990s and was successful in bringing several new machine technologies to the country. (Such a condition is invariably imposed by China on its imports of foreign technology/goods). This practice was extremely advantageous to the purchaser in that the domestic company was instantly available to attend to all problems of use and servicing at a fraction of the cost of calling the foreign technical staff. DHI may take up this issue with other government departments and PSUs to restore this condition as a means for the faster development of the domestic machine tool industry.
- c. **Offset trade condition:** Parallely the government could consider introducing an offset trade condition on foreign supplies of machine tools above say Rs.10 cr value, to be supplied from domestic machine tool companies. The DHI may discuss this for inclusion in the National Offset Policy.

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Note: The NMCC PMO’s Report has made similar recommendations which are quoted below:

- *re-examine the present policy of permitting 100 percent subsidiaries of foreign companies in the manufacturing sector*
- *to review the current FDI policy from the point of view of transfer of technology as well as considerations of National Security;*
- *to identify technologies needed by the country from the point of view not only of general technological development but also from the strategic point of view; and*
- *to identify specific areas of technology in which the FDI should be attracted along with appropriate conditions including of transfer of technology*
- *all the offset policies including the one under consideration in the Commerce Ministry should mandate technology transfer in addition to manufacturing content;*

- d. **Acquisition of companies abroad:** One way of obtaining technology is by selectively acquiring leading international companies. This route has been systematically followed by the Chinese government in acquiring machine tool companies in developed countries Europe (around 15

companies have been bought by China). The Indian government may facilitate selective acquisition of foreign machine tool companies with technology and market strengths as a strategic measure to support Indian machine tool industry and manufacturing competitiveness. The optimum way to do this would be through p-p-p companies of government and private companies but ensuring the commercial autonomy of the resulting venture through suitable equity ratios and management structure.



## 7 Capital Goods Industry Support Measures: Machine Tools

The government has indeed taken a much required approach to the development of the capital goods sector, in which machine tools is included. The machine tool industry is, like many other sectors, widely dispersed across the country. The major centres are:

- a. Bangalore and Karnataka
- b. Hyderabad
- c. Pune
- d. Rajkot, Bhavnagar in Gujarat
- e. Delhi, Gurgaon and NCR
- f. Ludhiana, Jullundhar and Batala in Punjab

Broadly, the industry can be said to be concentrated in the South, West and North. The southern units in Bangalore and Karnataka contribute around 50-60% of the industry's turnover. This is due to the historic background of machine tool industry's location and the setting up of HMT. Pune has several large units such as TAL, Premier, Electronica and many small units. Gujarat is a strong producer of conventional machine tools (GPMs) but has of late emerged as a strong producer of CNC machines as well. The northern units still produce only GPMs and although one of the earliest machine tool industry location in the country, have not modernized or kept pace with technological developments. There are also machine tool units in Chennai, producing niche products and special machines in small volume.

It has been pointed out (see sec.13) that for various reasons the entry of new investors into machine tools is not very likely, and the growth of the industry will have to be through support and encouragement to existing companies. As this cannot be done for individual units, the government's plan to support capital goods at the industry level is very appropriate and welcome.

The support measures for the machine tool industry should aim at an integrated development of the industry majors along with the smaller units and thereby bring synergy between them for the betterment of the industry. It is in this context that the support measures have been structured along the following lines:

### 1. Machine Tool Parks:

The success of Taiwan as a major machine tool producing and exporting country can be attributed to the machine tool park town of Taichung. This place co-locates machine tool assemblers and a chain of component and sub-system suppliers. Machine tools are built along the building block principle by assembling the required elements to make up the final product. Machine tools and their components/sub-assemblies are also exported to machine tool builders across the world. Indian companies also import such elements from Taiwan. Such an approach has led to Taiwan attaining the 6th place in machine tool production in the world, with a 80% export content. (Ref: Gardnerweb)

This approach is nothing new, and in fact India had pioneered this while setting up HMT in Bangalore along with its own "industrial estate" to locate small units to supply elements of machine tools to HMT main factory. This was so successful that the initial entrepreneurs have grown and branched out to their own industries.

The Machine Tool Park (MTP) that is being conceived now is a modern version of the industrial estate of the past. The MTP is expected to host a few (say 1-3) machine tool companies making the final

products. The rest of the units in the park would supply components, sub-assemblies and services to the main units to the latest design and technology. There would be close cooperation between them to design and develop these items to meet the market needs. The park would also host service providers both soft and hard to support the main units. In addition, the park is conceived to have the entire auxiliary services required to complete the machine tool producing chain from order to dispatch. The Common Facility Centre can be located in such a Park with advantage.

**The primary benefits of the MTP are as follows:**

- Each unit will focus on a core area of business, developing designs, technology, ensuring quality and service to each other.
- A close cooperation between the main producers and the suppliers is expected to lead to better designs and the latest technology becoming available
- By proximate location, issues of quality, delivery and service can be resolved immediately
- Main units' focus can be on producing the best machines while helping smaller ones to do likewise with their outputs.
- The co-location of CFC and Business and Market development Centre at the Park will bring the critical manufacturing support to all the units, thereby improving product quality and technology and market access.
- Other facilities like Logistics and bank/financial/regulatory/administrative facilities within the Park will reduce the burden on the manufacturing units in day to day operation and release their resources for more direct activities.
- It is anticipated that a park will take the industry to a new orbit, and open up opportunities both within the country and abroad.

A schematic diagram of a Machine tool Park is given in the figure on page 42.

Components of a typical machine tool park and estimated investment is given below:

	<b>Component of Machine Tool Park</b>	<b>Approx. investment Rs.crores</b>
1	Land, typical 200 acres at Rs.30 lakhs per acre	75
2	Infrastructure (Power, roads, water, sanitation, fencing, landscaping, STP etc.)	75
3	Buildings to house admin and management, banks/regulatory bodies, security set up, estate maintenance and other essential services	50
4	Tech centre, auditorium, hostel, living quarters for essential staff, school, medical centre and community hall	50
5	Total investment in setting up the Park infrastructure ( <i>per Park and excluding manufacturing units</i> )	250

(These are approximate)



The park as above can host around 1-3 main machine tool units, and around 60-100 SMEs depending on the nature of the units. Parks can be located in the vicinity of machine tool units or clusters; however, if this is not possible they can be located some distance away. Since the parks are expected to develop as totally self contained entities short distances of say 100 km should not matter provided quick and easy access to the existing units is possible through highways etc.

It may be pointed out that the primary support from the government is required in obtaining suitable land for the parks. The units which will invest in the park can even be persuaded to shift their existing facilities to the park with its new and modern ambience. Although the setting up of the park is expensive, part of this may be recovered through sale of plots and charges on the units, but a complete recovery may not be possible as this would make it unviable for units to locate there.

Location of MTPs: As pointed out above, there are essentially three machine tool industry clusters where the parks would be an advantage. Accordingly, three parks may be considered, one each in the south, west and north.

## **2. Common Facility Centres:**

The development and upgradation of the machine tool units, especially the smaller ones, can be considerably strengthened by setting up Common Facility Centres (CFC). These CFCs will provide certain critical manufacturing facilities which the individual units would not be able to afford at all. These are typically precision machining, large part machining, heat treatment, foundry, measurement and quality, material testing etc. Modern machine tool technology demands high accuracies from component machining if the final machine has to be accurate to microns. It requires sophisticated measurement and metrology to ensure these accuracies are met. Machinery and equipment for these are expensive, and a CFC would be an ideal way to support SMEs in moving up the quality and technology ladder.

SMEs can also benefit from the availability of design and engineering support at the CFCs to improve product design, functional and aesthetic aspects. Some testing and inspection facilities would round off the facilities at the CFCs to make them really useful to the SMEs. A certain amount of training can also be imparted through experts in various aspects of machine tool technology both as common interventions and as unit specific support.

A typical CFC for the machine tool industry would be equipped with the following machinery/equipment/facilities:

- Computer aided design facilities (CAD) along with analysis (FEM) software for optimization, simulation of the new machine
- A modern foundry to produce high quality machine tool castings
- Critical machining facilities for large machine tool structural castings. Machines like 5-side plano-millers, precision boring machines will be required.
- Medium size machining centres for the machining of medium sized components
- Jig-boring or high precision machining centres for machining critical components such as spindle housings.
- High precision grinding machines for machining precision components such as spindles and other round parts
- Gear grinding machines
- High precision co-ordinate measuring machines
- Measuring equipment, laser equipment and standards room
- Test beds for assembly of machines and testing

- Specialized test instrumentation and equipment for evaluating cutting performance, accuracy/precision, productivity, spindles, vibration and dynamic characteristics of machines etc.
- Material testing equipment
- Related material handling equipment including cranes.
- Technical Information Centre including IP related activities

The exact facilities would depend on the kind of machine tools and related items being produced by the units expected to utilize its services. For example, the entire facility would be required in Bangalore which produces more modern machines. The facility could be scaled down in the north, where companies produce relatively simpler machine tools. A tentative estimate of the capital investment that would be required to set up such CFC is given below: *(The cost of land has been taken high as the CFC would have to be in close proximity to existing machine tool industry units/clusters).*

	(Rs. Cr)
a) Land + development: 20 acres at Rs. 100 L per acre:	20.00
b) Building for technical functions: 3000 sq.m @ 45000/sqm	15.00
c) Workshop buildings: 5000 sqm. @ 30000/sqm	15.00
d) Infrastructure, machinery, equipment and shop facilities	150.00
<b>e) <u>Total estimated capital investment per CFC</u></b>	<b>Rs. Crores 200.00</b>

It can also be considered that the CFC could in fact be located within the machine tool parks. This would have the big advantage that the CFC can render close support to the units in their product development and upgradation plans and also provide the critical manufacturing facilities. In both cases these can have a very attractive revenue model justifying the investment in the CFCs.

The CFCs are expected to render services to the machine tool companies on chargeable basis. So it can be a revenue model where the running costs and a part of the initial investment may be recovered from users over a period of time.

Location of CFCs: Provisionally, three CFCs may be considered, one each in the south, west and north. The actual location could be firmed up after a study of the units in each area, the existing facilities and the need for new facilities.

### **3. Business and Market development support:**

Capital goods manufacture requires to be supported by a strong marketing set up and high productivity through internal efficiencies. While large units have the required strengths, the small and especially the medium units need handholding in this area. The support measures may take the form of soft support to implement training and measures to improve these areas in the working of the units. These could be as follows:

#### **Manufacturing efficiency:**

- Use of CAD/CAM in product design and development, manufacture
- Training in best manufacturing practices and processes
- Implementation of IT as a measure to improve internal control and management effectiveness, stressing IT's role as a DSS in real time
- Implement lean manufacturing concepts
- Productivity improvement
- Effective vendor development and supply chain management
- Cost control measures; bulk purchasing by cluster etc
- Resource sharing between units

- Energy efficiency management
- Electronic commerce including technical document exchange etc.
- Marketing development:
  - Training in marketing skills and tools
  - Domestic market development
  - Export market development
  - Participation at international trade shows
  - Product management

Business development support is generally extended to clusters of companies having a common agenda; however, it can also be used to provide individual unit intervention where justified.

The Ministry of Commerce and MSME ministries also provide similar assistance to SMEs in various industry sectors. It is advisable to avoid any duplication of the schemes. The DHI support scheme may be extended to both SMEs and large units many of which would benefit from such support.

As these schemes are for common benefit to clusters of companies, an allocation of Rs. 10 cr. per year may be made, amounting to Rs.50 cr over a five year period.

#### **4. Skill development support:**

The support measures foreseen by DHI in its scheme are limited to providing incremental training inputs to the machine tool industry manpower. It is advisable to look at the situation holistically and make allocations to enable the establishment of education and training institutions as described above. Detailed action plans are given in sec.8 of this report.

Summary of measures under the CGI support measures: The following is a summary of the recommended measures:

	<b>Approx. investment Rs.Cr</b>
<b>Machine Tool Parks (3)</b>	<b>750</b>
<b>Common Facility Centres (3)</b>	<b>600</b>
<b>Business &amp; Market Development</b>	<b>50</b>
<b>Total (excluding Skill development)</b>	<b>1400</b>

## 8 Corpus Fund for machine tool industry investment

The estimated demand growth for machine tools, resulting in an aggregate demand of Rs. 60000 – 70000 cr over the next five years will require the machine tool industry in India to respond with higher production volumes. If a market share of 50% is sought to be realized as set out in the Mission statement for the industry, the Indian machine tool industry will have to output around Rs.7500 crores by 2014. This represents a substantial increase from its present production of approx. Rs.2500 cr. The incremental output will require fresh investment. Assuming an output ratio of 1:2, the additional investment will be in the region of Rs. 2500 cr. between now and 2014.

The high interest rates in India act as dampers to investment in the machine tool industry in view of its high initial investment and long gestation period. Given that the growth of this industry is vital and of strategic importance, government must formulate suitable financing schemes to attract investment to this industry.

It is recommended that the government may set up a corpus fund of Rs.2000 cr. at a lower interest rate to finance capital investment in machine tools. This would be in the nature of a revolving corpus and could have the following broad terms for utilization by the industry:

- a. For initiatives for technology / new products / markets development, capacity enhancement
- b. In form of soft loan, in proportion to last 3 years average turnover. (Considering total for Indian industry today is about 3000 Cr, if Rs. 2000 Cr. corpus is available, and 50% of this (1000 Cr.) is to be used for seed capitalization, this is roughly 30% of average 3 year turnover, which can be the guideline.)
- c. 50:50% loan & industry contribution in the initiative
- d. Low interest rate (at Libor rates) and initial moratorium of 2 years (Only interest payment in first 2 years) + 5 years repayment.
- e. All 100% assets or IP created against both contributions to act as a security for the loan
- f. Repayments & reflows to constitute continuation capital, in addition to balance 50% corpus.

The availability of this corpus would encourage modernization, capacity creation and fresh/expansion investment in machine tools. The scheme could be administered through any of the scheduled banks.



## 9 Skill gaps and measures to bridge

Skill development is undoubtedly one of the most important inputs required to secure the growth and development of the machine tool industry. The original skills were imparted by collaborators in the 1950s and 60s in HMT and later in the 80s through JVs formed. After that the skills have been largely locally trained, and with the change in technology to CNC machines the training became weaker with time. At present the industry has no agency which imparts the basic machine building skills in a formal way and this reflects in the compromised ability of the industry to build high quality, reliable products.

The machine tool industry has seen rapid changes in technology over the last two decades which has resulted in both an erosion of skills among existing employees and the non availability of new entrants with the required skills. Companies have therefore fallen back on internal training programs to impart the required skills to employees. The skill gaps may be summarized as below:

Employee level	Skill gaps (only specialized skills)
Workers	<ul style="list-style-type: none"><li>a. Basic machine tool technology</li><li>b. Operation of machine tools, including CNC</li><li>c. High precision machining of structures, spindles etc</li><li>d. Scraping for machine assembly</li><li>e. Assembly of high precision spindles, ballscrews</li><li>f. Clean assembly of hydraulics, pneumatics etc.</li><li>g. Trouble free assembly of electricals</li><li>h. Self inspect/test and certify</li></ul>
Supervisors and technicians	<ul style="list-style-type: none"><li>a. All of above</li><li>b. Supervisory ability to check, correct and certify</li><li>c. Developing work instructions independently</li><li>d. Maintenance, issue and use of right tools</li><li>e. Standards and procedures</li></ul>
Servicing staff	<ul style="list-style-type: none"><li>a. Basic machine tool knowledge</li><li>b. Assembly, inspection and testing</li><li>c. Detailed product knowledge</li><li>d. Diagnostic skills; use of tools; remote trouble shooting</li><li>e. Servicing as a tool for product improvement</li></ul>
Shop engineers	<ul style="list-style-type: none"><li>a. All of above</li><li>b. Knowledge of process, tooling, fixturing etc</li><li>c. Improving shop productivity</li><li>d. Maintaining high shop environment (5S etc)</li><li>e. Motivating deputies to improve (Kaizen, cip etc)</li><li>f. Employee relations</li></ul>
Shop managers	<ul style="list-style-type: none"><li>a. Best practices in industry and application</li><li>b. Process improvement and planning</li><li>c. Quality improvement techniques, 6 sigma, 7 QC Tools</li><li>d. Waste elimination, cost reduction in manufacturing</li><li>e. Innovative skills</li><li>f. Initiative and leadership skills</li></ul>

Designers	<ul style="list-style-type: none"> <li>a. Broad knowledge of latest metalworking technologies</li> <li>b. Basic machine tool design principles</li> <li>c. CAE and Desktop prototyping</li> <li>d. DFM, DFA, DFS etc.</li> <li>e. Product life cycle management</li> <li>f. Environmental and regulatory concerns</li> <li>g. Creativity, innovation skills</li> </ul>
Process engineers	<ul style="list-style-type: none"> <li>a. Broad knowledge of latest metalworking technologies</li> <li>b. Machine tool related manufacturing techniques</li> <li>c. Latest methods, machines, processes, materials, tools</li> <li>d. Shop Metrology, measurement technology</li> <li>e. Maximizing productivity, minimizing cost</li> <li>f. Quality improvement techniques, 6 sigma, 7 QC Tools</li> </ul>
Marketing engineers	<ul style="list-style-type: none"> <li>a. Knowledge of metalworking technologies, machine tools</li> <li>b. Pricing, selling in a competitive market</li> <li>c. Selling to a technical buyer</li> <li>d. Getting competition knowledge</li> <li>e. Complete product costing knowledge</li> <li>f. Customer component, process knowledge</li> <li>g. Selling to government sector</li> <li>h. Export market development and export procedures</li> </ul>
Senior management, Executive cadre and entrepreneur owners	<ul style="list-style-type: none"> <li>a. Visionary growth and development</li> <li>b. Strategic business initiatives</li> <li>c. Countering import threats</li> <li>d. Developing Indian machine tool MNCs</li> </ul>

The above table lists only the more specialized skills that are gaps in the industry. There are gaps among those presently employed in the industry. The gaps are most felt in fresh technicians and graduates entering the industry. Whereas recruits to the IT industry go with basic programming language skills and programming knowledge, such is not the case with machine tool industry entrants. Most of them do not know of the basic metalworking technology or the latest developments.

Correcting this situation will require a systematic approach to identify present weaknesses, new requirements as the industry moves to higher technology and precision levels and then come up with a plan to bridge these gaps through suitable measures. The skill gaps need to be filled not only at the worker or shop floor levels, but it should address supervisory and management positions as well. An important component is to develop the educational and training establishments to address the specific requirements of the machine tool industry.

### Recommendations on actions to be taken:

- **NSDC to make an in-depth study:** This study of the existing manpower will gather more exact information on skill gaps, and future requirement of manpower in different grades, disciplines and skills. This will serve as a base for further action.
- **Draft new curriculum** for certificate and diploma courses specifically oriented towards machine tool technology. There are no such courses at present. Upgrade the physical facilities with modern machine tools for imparting practical knowledge and skills.

- **Introduce new courses in machine tool technology** in engineering colleges and IITs. They should be both at under and post graduate levels. The accent should be on design, development and process engineering. The institutions running these courses should have close links with machine tool industry and with educational and R&D institutions abroad, and the curriculum should be based on the latest machine tool and manufacturing technology.
- **Include CMTI** in designing and running higher courses in machine tools and manufacturing technology jointly with academia. Initial steps have been taken by CMTI in this direction.
- **Set up training institutions exclusively for machine tools**, with machines, equipment and tools to impart practical training and knowledge in machine tool operation, design, building, servicing and application etc. to students. The same facilities should also train industry employees to update their knowledge and skills. (Please see below for model institutions)
- **“Train the trainer” programs** are very essential. The teaching staff at our ITIs and colleges should also receive training in modern machine tool technology. Industry may assist in this.
- **Support IMTMA to set up training facilities** maybe with foreign tie-up to run vocational/practical and continuous improvement programs in machine tool technology for the employees and freshers wishing to join the industry.
- **The training of machine tool industry executives** should not be lost sight of. The future of the industry is dependent on how senior executives, top management/directors and owner-entrepreneurs are able to steer their companies in the liberalized economy with competition from across the globe and. It is suggested that a Centre of Excellence for developing managers, leaders and visionaries for the industry be set up which will serve not only the machine tool industry but the entire manufacturing industry in the country. Such a centre could extend its activities to the larger manufacturing sphere by adopting the VLFM program which is currently being run by CII in cooperation with NMCC.
- **Academia – industry exchange:** In countries like USA and Europe there is a constant exchange of academic professors and industry experts. This practice may be followed in India. Academic and R&D experts may serve in industry, even on the board of companies, and industry experts may teach and work for higher degrees while still in service. Industry may also sponsor machine tool chairs at IITs and reputed engineering institutions for a continuous R&D program.

#### **Institutions that can serve as models in setting up training institutions:**

- a. **PROSchool set up by AFM:** The Spanish Machine Tool Association has set up a dedicated training school specifically for machine tool technology. This is equipped with all necessary teaching and training aids and experienced staff to train school passing students to acquire a trade certificate for machine tool technician. This training centre runs parallel with the formal education system with government recognition and imparts both training and apprenticeship at the machine tool companies in Spain. Employment is generally guaranteed after completion of the course which lasts 3 years.
- b. **TTTI set up at TKM, Bidadi:** Toyota is widely recognized for their training methods to produce technicians for their factories producing high quality automobiles. At their factory in Bangalore Toyota Kirloskar Motors have established the TTTI (Toyota Technical Training Institute) which imparts a 3-year course of training and study which leads to a highly trained automobile technician. The students passing out from TTTI are absorbed by Toyota or else they can find ready employment at other auto

majors without difficulty. The TTTI is a completely independent campus with educational and hands-on training facilities designed by the company to suit its requirements. It has a hostel and the course is residential.

The machine tool industry can benefit from the establishment of a similar training school for technicians in machine tools.

- c. **German model:** Producing engineering graduates and post graduates ready for the machine tool industry is an important requirement. This can be done best by following the German model whereby colleges imparting undergraduate education include attachment to industry as an essential part of the curriculum. The first step is to develop undergraduate courses of study in machine tool technology at several engineering colleges in the country. By doing this at colleges near the industry clusters, compulsory practical training and internship is easy to include in the curriculum. Post graduate courses should likewise divide time between study course and industry attachment. Exchange of faculty between industry and academic institutions is necessary to bring a practical and industry orientation to students and an academic orientation to industry professionals.

CMTI has just launched the ACAEMT with precisely such content and it needs to be replicated in the formal education system urgently. This is the only way to graduate students ready to join and contribute in the machine tool industry.

➤ **Investment on skill upgradation:**

The investment can be worked out based on the skill gap survey recommended to be carried out by NSDC. The implementation measures will take the form of:

- a. Upgrading ITIs with new machines, equipment and facilities
- b. Upgrading engineering colleges with machines, equipment and facilities
- c. Setting up dedicated training centres
- d. Implementing the training programmes

As an indicative figure, an investment of Rs. 10 crore per location may be allocated for a and b above. If 5 institutions each are to be so modernized the total investment on 10 institutions will be Rs.100 cr.

The setting up of dedicated training centres (c) will require green field projects at three locations, each with investment which includes land, buildings, a hostel and machinery, equipment and facilities. A provision of Rs.60 cr may be made for these.

A rough estimate of the investment in creating training and skill development facilities across three regions will be around RS.160 cr. The actual training costs will have to be budgeted in addition.

The Centre of Excellence for executive development as recommended will be either a greenfield project or a major inclusion at one of the existing facilities. In case it is a greenfield project an investment of Rs.40 cr. may be included to set it up.

Summary:

	(Rs.crores)
Upgrading ITIs (5)	50
Upgrading engg colleges (5)	50
Greenfield training centres (3)	60
CoE for executive development	40
<b>Total investment</b>	<b>200</b>

## 10 Summary of various measures recommended

A summary of the various measures recommended in the foregoing sections is given below:

	Recommended measure	Financial outlay (Rs. Cr)	
		Total	Per yr
1	Technology/R&D	2000	
2	Capital Goods Industry Support Scheme: Parks (750) + CFC(600) + Business development (50)	1400	
3	Revolving Corpus Fund	2000	
4	Skill Development	200	
	<b>Total outlay required from government</b>	<b>5600</b>	<b>1120</b>
5	<b>Revenue implication of fiscal measures suggested (per year)</b>	<b>575</b>	<b>575</b>

The implementation of these measures is required for the long term development and growth of the industry, which in turn is very critical to countering technology denials and to ensure manufacturing technology security for the country. These outlays must be viewed in that larger perspective and not in the short term. These investments should be weighed against the anticipated demand of Rs.60,000 crores + for machine tools over the next five years. If the required financial investments and policy initiatives are not made, it will almost definitely result in the Indian machine tool industry being totally eclipsed by imports. This will have serious implications for the security of the strategic sectors of the country.

These outlays are very preliminary estimates. Each recommended measure needs to be worked on in detail by a qualified team with expertise in the area and more exact estimates prepared. However, these estimates may be taken as indicative figures, and considered for making the required plan outlays and budgetary provisions by the government. Most of these investments are in the nature of soft loans for corpus fund, R&D, technology upgradation etc., and therefore do not constitute a permanent burden on the government. The outlays towards machine tool parks, common facility centres etc. may be recovered partially at the time of sale of industrial plots in the Technology Parks and through charges for services rendered at the CFCs. The initial investment may be seen as a catalytic measure by the government.

It may also be pointed out that the machine tool industry by itself will not be able to raise the resources as the industry is of comparatively small size. The participation of large user industries in the development effort is one of the best ways of taking this industry forward, by joint development through risk-sharing development contracts and joint development programs. This will reduce the direct burden on the government in making these outlays, which can then be restricted to the core areas and in creating the infrastructure facilities for the industry's development.

## 11 Imports, including used machine imports

### Import of machine tools:

The import of machine tools has increased substantially over the last decade in response to market demand from various sectors, notably the automotive sector and lately the aerospace and energy sectors. The rapid expansion of these industry sectors has led to the demand for the latest technology machines of various types. The import data is summarized for the last five years in the Table below.

#### **IMPORT OF MACHINE TOOLS**

(Rs. Crores)

Year	Imports	New	Used
2009-10	4842	4203	639
2008-09	6271	5629	642
2007-08	6415	5463	951
2006-07	4655	3818	837
2005-06	2898	2347	551

Import of new machines is largely in CNC turning and machining centres, grinding, gear cutting, milling-boring machines and metal forming machines. It has already been pointed out that the surge in imports has led to the shrinking of the domestic market share for the Indian machine tool industry to around 30% now. The reasons are mainly:

- Capacity constraints of domestic manufacturers (for standard machines)
- Low volume of production (grinding, gear cutting, metal forming etc.)
- Technology gaps (high precision, multi-axes machines for aero-space, power, auto etc.)
- Gaps in the production of large machine tools (power, railways, infrastructure)

The measures required to bridge these limitations by way of creating fresh capacities and closing technology gaps have been discussed in earlier sections of this report. The recommendations need to be implemented expeditiously to help the domestic machine tool industry recover lost ground as soon as possible, in line with the Vision and Mission statements and objectives laid down.

### Used machine imports:

The Trade Policy announced on 1<sup>st</sup> September, 2004 has removed all restrictions on import of used machine tools i.e. from 1st September, 2004, used machines are allowed for import without any age restriction and even without actual user condition. The table above indicates actual import of used machines during the last 5 years. It is observed that the import of used machines have significantly increased during last few years i.e. after removal of the actual user condition. In terms of quantity almost 40-50% of the machines were imported in used condition.

One of the important reasons for the import of used machine tools is the closure of a large number of manufacturing industries in Europe and USA, with these activities moving to China, South-east Asia and lately to India. This has made available a very large number of used machine tools of various types from Europe, many of them in good condition and at very low prices compared to equivalent new machines (typically one-third to one-fourth). Indian users have been importing such machines to augment their production capacities at very low cost.

Further analysis of the data available on import of used machines suggests the following:



- Most used machines imported are more than 10 years old
- Total import of used machines in terms of value is around 10-15% of the total import consumption of machine tools.
- Grinding Machines, Boring & Milling Machines Gear Cutting Machines, Presses account for around 45-50% of the total import of used machines. Indian industry is weak in these areas and there is a clear need to establish adequate capacity to meet the growing demand for these machine tools.

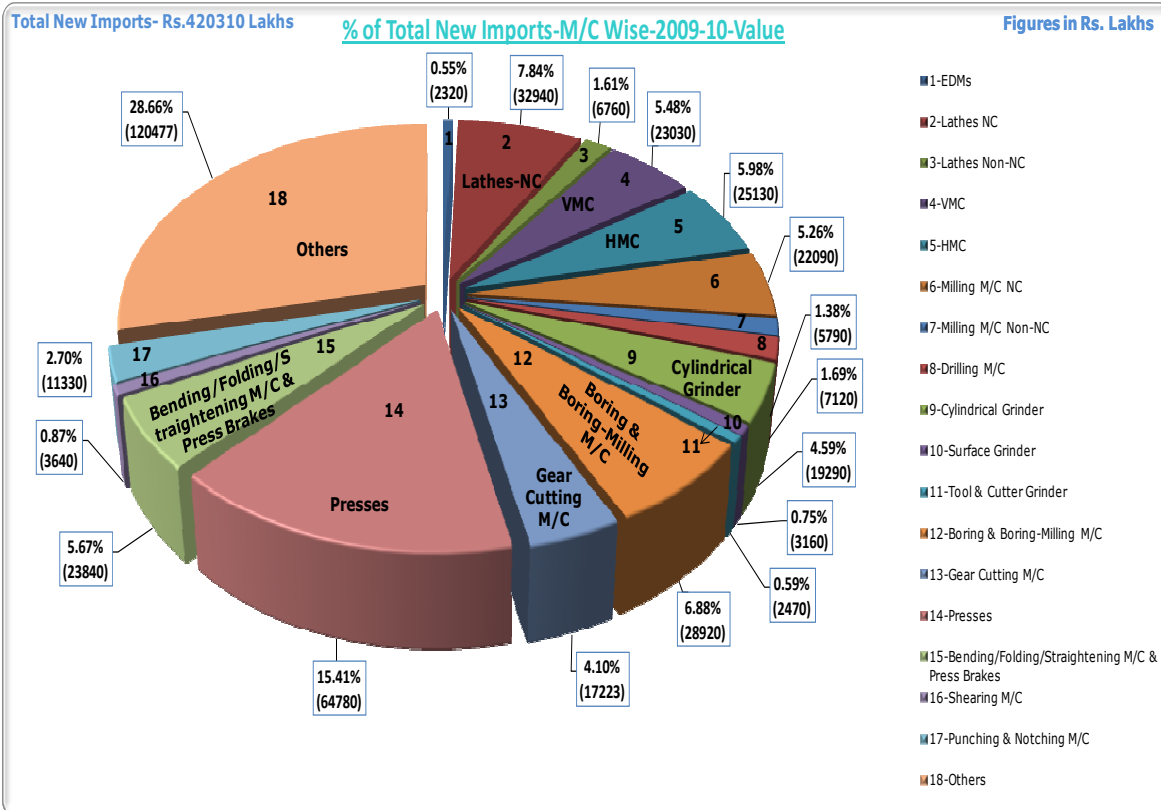
Although import of used machine tools is affecting Indian industry, there appears to be a need to continue to allow import of used machines at least in certain categories where Indian industry is currently weak. However, at the same time, import of low priced obsolete technology machines in used condition must be strongly discouraged.

**Recommendations:**

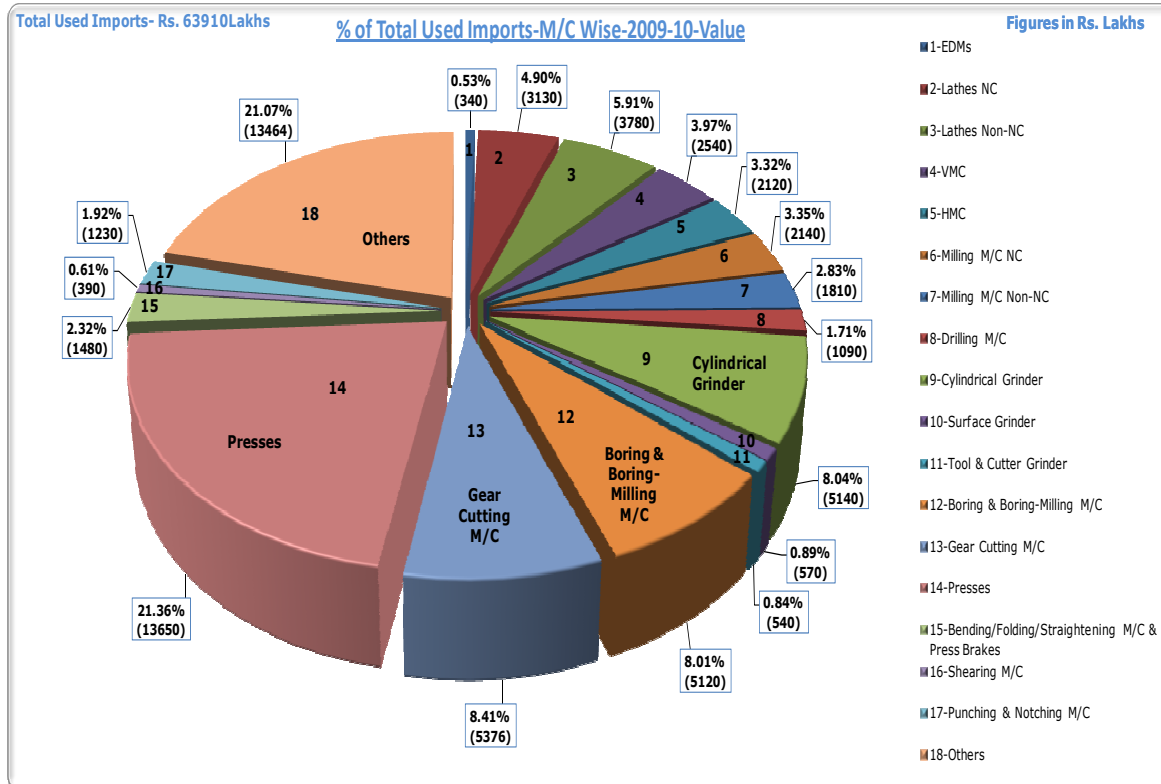
Government may consider the following measures to achieve this objective:

- Channel the import of used machine tools through 2 designated ports viz. Mumbai & Chennai ports. This will facilitate compiling more exact data and better monitoring of such imports (type, age, price, origin etc.)
- Levy a uniform 30% custom duty on import of used machine tools (against 7.5% on new machines).
- Disallow depreciation benefit on used machine tools.
- Impose "Actual User" condition for all imports of used machine tools under OGL.

Pie-charts of the composition of new and imported machine tools for 2009-10 are given on the next page. These are typically the trend of imports for the last five years, showing where the Indian machine tool industry needs to develop new products/technologies, invest in capacity and increase production volumes. The import of machine tools, both new and old, in fact represents an opportunity for the Indian machine tool industry which it can exploit.



**Pie-chart showing composition of new machine imports, 2009-10**



**Pie-chart showing composition of used machine imports, 2009-10**

## 12 Suggestions for restructuring HMT and HEC

The government has constituted a committee to study the restructuring of HMT/HEC including the option of a merger between HEC and HMT. A very detailed study of the two companies and the ground situation would be required to reach any view on this issue. As such this sub-committee is not in a position to propose an action plan to restructure the two companies. The committee would however like to submit the following suggestions which may help the government in the restructuring process:

- a. **Potential of HMT and HEC:** Both HMT (Machine Tools) and HEC have potential to become leading companies in machine tools in India. They can aspire to become global companies, given the situation of the industry abroad.  
Considering that HMT has five machine tool units (Bangalore, Pinjore, Kalamassery, Hyderabad, Ajmer) and around 4000 employees, the company should output at least Rs.1000 cr. per annum, at a nominal Rs.25 lakhs per employee turnover. Together, HEC and HMT have the potential to reach an annual turnover of around Rs.1500 cr. (It may be mentioned that the best private sector companies have per employee turnover going upto Rs.100 lakhs.). This **potential** may be kept as a target while restructuring the companies.
- b. **Production facilities and manpower:** It is accepted that both companies being PSUs and established at a time when the infrastructure was non-existent, carry certain non-core activities and social costs which affect their financials. Older technology requirements and historical recruitment practices have also saddled the companies with manpower that is more than required for modern times. Both companies require selective modernization of the production facilities and manpower restructuring. These aspects may be given due consideration so as to restore some parity with other companies and make the companies cost competitive.
- c. **P-P-P companies / Acquisitions for technology:** After the end of collaborations with foreign companies in the 1960-80s, the technology and product development, though strong, has not kept pace with the rapid advances abroad. There is no scope for collaborations now since most foreign companies have their own presence in India and sell direct to users.  
Under these circumstances, the restructuring process may seriously examine the possibility of p-p-p companies with leading manufacturers abroad both to infuse latest technology and as a means to access the domestic and international market. Even this may not be attractive to foreign companies. As an alternative, the government could consider creating conditions for acquiring select foreign companies having synergetic possibilities with HMT units and HEC. (Many companies in Europe are available for sale/takeover and are being bought by China as a strategy; two acquisitions have been made by Indian machine tool companies in recent years)
- d. **Spinning off as independent companies:** The restructuring process should lead to lean, efficient units capable of functioning in a fiercely competitive market. The government may consider making each unit of HMT and HEC independent companies with specific product/technology focus (they already exist). This way p-p-p and possible acquisitions of foreign companies will have a better chance of success. The restructuring process may be driven by a vision to make each of the units an international company in its own right.
- e. **Divestment to attract investment:** It is needless to add that in today's market driven conditions with competition from across the world, HMT and HEC will have to be free to respond to market forces exactly as any private company would do. One way would be for the government to divest at least 51% in these companies and make these companies entirely board managed. This would pave the way for p-p-p companies/acquisition of foreign companies and may also attract Indian investment, given that there are strong production capacities in all these units. Such a measure would push the valuation higher and fetch good returns for the government when it eventually disinvests completely (Maruti-Suzuki is an example)

## 13 Reasons for lack of investor interest in machine tools

Traditionally, machine tool industry worldwide has been family owned businesses in Britain, Germany and other countries. Some earlier companies were set up as subsidiaries of large automobile companies (Renault, for example) or armament manufacturers (Oerlikon, Manuharin etc.). In Japan and Korea many machine tool companies are part of large corporations with wide manufacturing interests (Mitsubishi, Daewoo, Toyoda etc.) Over the last 10-15 years the global machine tool industry has undergone major changes. Many of the older companies in Europe have undergone consolidation (Deckel-Maho-Gildemeister) or have been sold. By and large, individual stand-alone machine tool companies have been reducing in number across the world due to low profitability and fluctuating market demand conditions. Consolidation of like technology companies (grinding, gear cutting in Europe) are the order of the day. The global machine tool industry has undergone extensive restructuring to attract investment and financial backing which was otherwise difficult to come by.

The machine tool industry in India has gone through three phases:

- 1 Pre-independence:** There were two companies manufacturing machine tools: Kirloskar (Harihar in Karnataka) and Cooper Engineering (Satara/Pune). These companies continued in the business after independence also.
- 2. 1960-1990:** This was the growth period of the industry. The major investment was by the government in setting up HMT. During this period a large number of new products of international technology were introduced through collaborations between HMT and foreign companies. The industry met the requirements of the then small automobile industry and defence production. During the 80s the industry (mostly HMT) also developed design competence and a slew of indigenous products, including the first CNC turning and machining centres were developed even though they were expensive and there was not a market for them among users.

During this period the industry was dominated by HMT and functioned in a largely protected mode. Customers could import machines but a difficult licensing procedure and “clearance” from HMT or other indigenous producers ensured that competition was kept limited. The industry also used this period to develop new machines to meet the auto industry needs, with new 2-wheeler and the LCV JVs coming up in this period.

This period (from mid 1980s) also saw the establishment of the first JVs with Japanese machine tool companies for producing current models of CNC machines. JVs were established by private companies such as Cooper, LMW. This spread the manufacture and application of CNC machines wider. HMT entered into collaborations for producing ballscrews (with CZ Jena) and CNC systems (with Siemens).

As a result of all these efforts the machine tool industry was able to have a near 90% market share in the early 1990s.

- 3. Post liberalization:** The real test for the industry came after 1991, when gradually the economy was liberalized and most industries including the machine tool industry was de-licensed. This period saw the emergence of technocrat-driven private machine tool companies and fresh investments. A number of new units were set up taking advantage of the liberalized economy. These units started with conventional machines but soon graduated to producing CNC machines. The foundation for the machine tool industry as it exists today was laid in the 1990s.

The period from 1990 to 2000 was a gradual growth period for the industry. It also witnessed the first competitive forces emerging, and the challenge for the older companies to transform into “new economy” companies. A few succeeded, but many did not and closed operations. Unfortunately, HMT and Praga, the main PSU units were unable to transform, and so entered a very difficult phase.

After a recessionary period during 2000-2002, the industry took on a high growth path from 2003 onwards. Thanks largely to the booming expansion of the auto and component industry, machine tool demand witnessed healthy growth and the industry grew at an average 25% from 2003 to 2007. However, fresh investments were limited, an exception being the investments made by a machine tool producer in Gujarat. Mostly, the industry improved production efficiencies and capacity utilization to the maximum extent to meet demand. Even though the Indian machine tool industry grew at 25%, the demand grew much faster, imports made a strong entry, and the industry has now a market share of only around 30%.

#### **4. Reasons for Lack of investor interest:**

It would appear that with such a strong market, there should have been fresh investments by existing companies or large industrial houses. This has not happened. The reasons may be enumerated as follows:

- a. Machine tools are considered “exclusive” and a difficult “art” to master.
- b. Fresh investments are high, especially if the factories have to be set up matching international standards. As a result, gestation period is high and returns are low.
- c. Profitability is not very high unless standard machines are produced in volume. Some Indian companies have been able to achieve this. Most Indian companies are small volume or niche producers. Typical profit margin is around 5-7%
- d. There is lack of ready, qualified and experienced manpower to start new ventures. Opportunities for training in machine tool technology are non-existent and are mostly within existing companies in limited scale.
- e. It is a field with periodic market fluctuation, heavily dependent on the auto and related manufacturing sectors. Machine tools are the first to be affected in an economic downturn and the last to recover. So investors hesitate to enter this field.
- f. Machine tool technology has developed far, and the Indian industry has not kept pace with international technology. Technology gaps and high cost of R&D discourage new entrants, who may be doubtful about the market.
- g. The free import of machine tools has given access to international companies to sell to users directly. 100% FDI allowed in machine tools enables foreign companies to enter the Indian market with no obligation to transfer technology to Indian partners. In fact foreign companies are very optimistic about the Indian market and most have set up marketing offices and technology centres to serve Indian customers. Actual investment in local production is very little. This scenario discourages new investors from establishing Indian companies as they would have no access to the latest technology.
- h. Pure economics also work to discourage large industry houses from investing in machine tools. With a present annual consumption of around Rs.8000 cr, even a 50% market share will be Rs.4000 cr for Indian companies. This comprises a large number of different products involving different technologies. The largest segment (CNC turning and machining centres) can offer a volume of around Rs.2000 cr. A new entrant can hope to get a market share of 20-30% in this segment. This would be around Rs.400-500 cr. and a profit of around Rs.40-50 cr. which would not interest any large house as a diversification opportunity. Machine tools are not “mass consumption” articles.

From the foregoing it can be seen that the industry is not an attractive destination for fresh investment in normal course for new ventures. For this reason some measures to attract investment have been suggested elsewhere in this report. The industry would have to largely depend on expansion of existing units to increase its capacity and output.

## 14 Countering technology denial for multi axes machine tools and CNC systems

As pointed out elsewhere in this report, the Indian machine tool industry depends entirely on imports for the critical items of CNC machines, of which the CNC, servo motors and drive controllers are vital components, in fact, the heart of the machine. These are imported from two manufacturers, one in Germany and the other in Japan, who supply these CNC systems to almost all the machine tool companies across the world. They have a market share of more than 80% worldwide.

The standard CNC machines use 2, 3 and 4 axes CNC out of which 3 axes can be simultaneously interpolated to machine 3D profiles. This capability is sufficient for most applications including die and mould manufacture.

Components in aerospace, defence, medical, instrumentation and nuclear industries have complicated profiled components which require simultaneous interpolation in 4, 5 or more axes. The export of CNC machines/systems with such capabilities is refused by the German/Japanese governments. There have also been instances when CNC machine tools meant for use by the machine tool companies have been refused export permission, if these machines exceed certain accuracy limits fixed.

The denial of these machines/CNC systems is done under the guidelines contained in the IAEA Circular INFCIRC/254/REV.7/PART 2 of March 2006 (Annexure 8) as a dual use equipment. It has placed the machine tool industry in a serious situation of uncertainty while responding to machine tool requirements from the strategic sectors in India. It also affects the overall manufacturing technology security of the country.

### **The following measures to counter technology denial are recommended:**

- a. **With IAEA:** The Government of India may take up this issue seriously with the concerned governments (USA, EU and Japan) and IAEA to exclude India from the application of the IAEA Guidelines since India has special agreements with IAEA on nuclear technology signed after the 123 agreement with the USA. It would be inconsistent to apply these guidelines to India.
- b. **Developing the CNC system, servo drives and motors:**  
In the long run, as a strategic measure, India will have to develop indigenous routes to securing technology for CNC machine tools equipped with 4, 5 and more axes simultaneous contouring (and higher precision levels), the CNC systems and the critical mechanical elements.

One route to this technology is to develop PC based systems with motion control cards and the software to realize the CNC capabilities. Servo drives and motors have to be sourced from independent manufacturers of which there are many internationally. This is a relatively easy and low-risk route that does not require the development of any hardware. This configuration is used by several independent control suppliers in the world. There is some experience in this field among machine tool companies in India as well. The IT industry has the capability to develop the multi-axes software. Some attempts were made to develop the CNC systems along this route but they did not go the whole road due to small demand and non urgency. With an increase in demand for such machine tools the development of this solution can be a viable proposition eventually; however the government should underwrite the development project costs.



**The development may have two distinct components:**

- One, to develop a standard, no-frills CNC system for the mass market of standard CNC machines in volume;
- Two, to develop advanced CNC systems with multi-axes capabilities for the aero-space, tool mfg, defence, power equipment etc. industries which are subject to technology denials.

Developing the servo drives and motors has to be a concurrent development project. The industry has some expertise in this field. This, together with competencies in electronics at various R&D institutions will have to be harnessed to develop servo motors and drive controllers suitable for high precision machine tool applications. This should be part of the R&D/Technology Development program.

The most appropriate approach would be to set up a p-p-p company which will take up the development **and** commercial production of the items. The government may underwrite the R&D costs and the p-p-p venture may pay a royalty to the government once it goes into commercial production.

**c. Developing the machine tools:**

The development of machine tools is within the capabilities of the industry. A few machines with 5 axes contouring capability have been built in response to the needs of the strategic sector. The development of high technology machine tools should be part of the R&D/Technology Development program enumerated in Sec.5.

**d. Developing the critical mechanical elements:**

As already enumerated in Sec. 5 the industry depends entirely on imports for the following items for CNC machines:

- Ball screws
- Anti-friction Linear Guideways
- High precision spindle and ball screw support bearings
- Measuring systems.

HMT manufactures ballscrews under a technology acquired from Carl-Zeiss Jena in the mid-1980s. These ballscrews serve normal requirements (upto 24 mpm) but do not meet the requirement of present day CNC machines with high traverse rates (60 mpm+). There is no alternative but to develop this technology through R&D, unless a tie-up with an established international company if possible. This is not likely. All the elements above have to be developed concurrently.

This project will need a consortium of machine tool companies, R&D institutions and an R&D group formed for the purpose. Investments in manufacturing equipment are necessary and the project must be structured as a development-cum-manufacturing unit. A p-p-p company is the most suitable route, with the government underwriting the development phase costs. This should be part of the R&D/Technology Development program enumerated in sec.5.



**Aerospace components requiring 5 axis machining**



**5 axis machine for Impellers, turbine blade etc.  
subject to technology denial**



## CNC Systems – Imported from Germany & Japan



**Servo motors & Drives developed by  
Indian machine tool company**

## 15 Chinese strategy for machine tools

Although not part of the terms of reference of the sub-committee, it is felt that a brief discussion of the Chinese machine tool industry and its strategies will be of interest to policy makers in the government. Some of these aspects are presented here.

### 1. Global position of China:

The Chinese global position in machine tools is given in the Table below, side by side with the Indian position:

Year 2009	China	India	Remarks
Consumption \$ bn	19.40	1.16	Chinese consumption 17 times larger
Production \$ bn	15.00	0.27	Chinese production 55 times larger
Exports \$ bn	1.40	0.012	India's export not significant
Imports \$ bn	5.80	0.90	Chinese imports mostly high tech
World rank - consumption	1	8	
World rank - production	1	19	

(Source: 2010 World Machine Tool Output and Consumption Survey, [www.gardnerweb.com](http://www.gardnerweb.com))

From this it can be seen that the Chinese are way ahead of India in machine tool consumption, pointing to a strong manufacturing orientation of the economy. India needs to reassess its strategies to substantially raise its manufacturing content of the economy. A strong machine tool industry is an absolute necessity to support manufacturing growth. The government may have to take whatever policy decisions are required to ensure this.

### 2. Chinese policy on the machine tool industry:

Reproduced below is an extract from the Chinese 11<sup>th</sup> Five-Year Plan document which enunciates clear missions for the Chinese machine tool industry over the next 15 years to 2020: (Source: American Machinist)

#### QUOTE

#### China Sets Sights On Machine Tool Development

##### Bruce Vernyi

A report released recently from China cited the internal development of precision CNC machine tools as one of the country's strategic needs and targets over the next 15 years. China currently is the largest machine tool consumer in the world.

The government-issued report, titled "Outline of the National Medium-and Long-term Planning for Development of Science and Technology (From 2006 to 2020)," identifies manufacturing as one of 11 major sectors of development China intends to pursue in the next 15 years, and specifically cited the

domestic production of precision machine tools as one of 16 core projects in science and technology chosen for growth.

The report indicates China's intention to emphasize the development of CNC control systems that will be designed for the machine tools. Also, the document notes plans to develop additional equipment, such as high-speed spindles, and the ancillary equipment needed for the machine tools, such as ball screws, robotic tool holders and tool-changing magazines, rotary tables, linear guided motors, and toolholding devices. The report was made available by China's official news agency in February.

Additionally, China's government identified its desire to produce high precision machine tools in two other recent reports.

Last September, a Chinese government document stated that China should reduce its reliance on imported CNC machine tools by developing its own machine tools and computer control systems.

Later, in its "Eleventh Five-year Plan period from 2006 to 2010," the Chinese government identified types of machine tools that it plans to build domestically over the next five years.

The machine tools identified in the plan include high-speed, high-precision CNC lathes and turning centers; four-axis machining centers; high-speed, high-precision vertical machining centers; CNC boring and milling centers; a variety of heavy-duty CNC machine tools; ultra high precision CNC grinding machines, including crankshaft and specialized grinding machines; wire EDM machines, including large, CNC EDM machines; metal forming machines; and automatic and specialized production machines. The five-year plan also was published in English by China's official news agency.

#### **UNQUOTE**

This shows that the Chinese have recognized the critical importance of the machine tool industry to the development of its economy, and the importance of reducing its dependence on imports. There are clear pointers for the Indian government here.

#### **3. An executive's experience:**

The Chinese regulations on machine tool commerce are laid down by the government keeping its national interests in view. Official documents are difficult to obtain, but one of the executives of the Indian machine tool industry who has served in the region for long has this to convey on Chinese policy on machine tools:

#### **QUOTE**

Chinese government has been using a proven formula for their growth of various industrial sectors. The pattern is set and is repeated for industries as and when needed.

Step 1 : Invite foreign players to set up manufacturing units with a JV in China. All kind of normal financial incentives such as tax break, VAT refund, export credit etc are given. The JV benefits from new technology, foreign players gets some access to domestic market. But main objective of foreign players of lower cost is achieved. This also establishes an export market for "Made in China" products.

Step 2 : A steady mfg base in place, Chinese government stops offering tax break etc for simple manufacturing transplant but offer that only to players who promise to bring in Technology, R&D to the country. They are also given more access to domestic market.



In the parallel, they select a few domestic players, for infusion of R&D funds (development program) to promote R&D and home grown technology. They set up specific engineering colleges for this industry. These selected domestic players specifically in Machine Tools industry used to be part of large industrial/ defense organization supporting in-house requirement. These get spun off and made stand alone to spearhead the industry growth. DongFeng Machinery (one of the top big 10 domestic players) is such an example.

They are known to offer big money for Chinese engineers/scientists who have been working overseas in the industry to return to China and set up R&D lab or industry. This is a very powerful tool as it ensures good technology and management skill infusion.

Lastly, they set up clusters of same industries in one area with all support industry. This ensures cooperation amongst the players in Supply Chain. e.g. Xuzhou area is known for all big earth moving/mining machinery industry. All big players including international players like Caterpillar, John Deere and also local players are located here as well their support industry

Guangzhou is known for electronics manufacturing.

Of course, they use other protective measures to support the domestic players which includes tax breaks, VAT return for export and at times regulating the extent of import machines that can be used by a manufacturing unit, higher tax of import (custom duty) if domestic grown technology is proven.

An important industry that is adjunct to the machine tool industry is the cutting tool industry. In the Chinese market, over 50% of market share is held by local companies. When cutting tool makers collaborate with machine tool industry, they can come up with solutions that can rival international brands.

#### **UNQUOTE**

##### **h. NMCC PMO report on Chinese strategy:**

The NMCC PMO's report has also highlighted the Chinese policy framework which is designed to promote local manufacture and technology transfer. The relevant extracts are quoted from the report below:

#### **QUOTE**

China has followed an industrial policy including the FDI policy which promoted domestic manufacturing growth. In addition to providing better infrastructure, labour flexibility/discipline etc., some specific policy actions put in place by Chinese Government have substantially contributed to the rapid growth of manufacturing in China. China has adopted a clear policy for promoting manufacturing as a primary goal in its growth model. Chinese policy included a clear set of incentives in terms of subsidies, concessions in taxes etc., for investment and promotion of manufacturing industries. China also has put in place policies in respect of the FDI which helped in the growth of domestic companies including technology transfer. For example, absorption of technology by local company, minimum capital requirement, local participation in the companies etc., are prescribed to ensure that the manufacturing along with technology is shifted to China. The macro economic policies such as the Exchange rate and Interest rate policies in China also have been made to subserve the goal of growth of manufacturing.

China has recently embarked on a revised manufacturing policy which has further sharpened the focus. The new policy aims at aggressively promoting value addition in manufacturing. For example, the concessions on VAT would be given to the companies on a graded basis with reference to the amount of local value addition. Also, to support the domestic industry with cheap availability of raw materials and inputs, China is using the export taxes on these materials as a tool to limit exports. This serves two purposes. The levy of export taxes ensures that the Chinese companies get cheaper raw materials and inputs while the countries that import these materials would have to buy it at a higher cost and, therefore, will be less competitive in terms of the finished products.

In sum, China has ensured that a variety of policy and administrative instruments are used for developing domestic manufacturing and promoting upgradation of technologies by domestic companies. The bottom line for China has been to pursue domestic manufacturing and acquisition/development of technologies including high technologies with a single-minded focus.

#### **UNQUOTE**

**4. Acquisition as strategy:** The Chinese government has adopted the strategy of selectively acquiring leading foreign machine tool and related companies which are available for sale. By this the Chinese get immediate ownership of advanced technologies as well as markets. The Chinese are known to have acquired ownership of the following companies in Europe and Japan:

- Waldrich Coburg, Germany: Large, heavy machine tools
- Shies, Germany: Manufacturer of Vertical Turning and Boring Machines
- Zimmermann, Germany: Manufacturer of 5-axis machining centres
- OKK, Japan

In all, the Chinese are reported to have acquired around 15 machine tool companies, mostly in high technology areas. The Chinese have also adopted an arms-length approach to the management of these companies. They are allowed to function in exactly the same way as before, developing new technologies, products and markets under their original brand name. By virtue of their ownership, all the technological expertise is in the hands of the Chinese who are free to apply them to their manufacturing needs, both normal and strategic.

By contrast, in India, only two Indian machine tool companies have acquired one company each in Canada and France. As discussed in sec.12, this approach may be one way to restructure the PSUs HMT and HEC.

#### **5. Study of the Chinese machine tool industry and government role:**

IMTMA is making efforts to have a detailed study of the Chinese machine tool industry made by an agency with the access and reach in Chinese industry and government circles to get correct and useful information. It is suggested that the DHI may support this study and also request its channels in the government and outside to collect information and data to the agency making the study. This study can be of immense use to the industry and DHI in moving government channels to enunciate suitable policies and support for this industry. The study which should be carried out by an agency having good access to Chinese industry, trade and government may involve an investment of around Rs.50-70 lakhs.





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## Chinese CNC system and Machine tool electronics

## Annexure 1: Minutes of the first meeting of the reconstituted Development Council for Machine Tools

No. 1/2/2009-HE&MT  
Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
HE&MT Section

Udyog Bhavan, New Delhi  
Dated, the 25<sup>th</sup> March, 2010.

To

As per the ANNEXURE-I

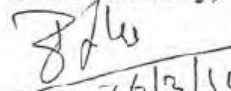
**Subject: –Minutes of the first meeting of the Re-constituted Development Council for the Machine Tools Industry held on 09.03.2010 at Delhi- reg.**

Sir/Madam,

I am directed to send here the Minutes of the first meeting of the re-constituted Development Council for the Machine Tools Industry held on 09.03.2010 at 11.30AM at Udyog Bhawan, New Delhi. Action points arising out of the meeting are also annexed as Annexure-II. It is requested that your response in the matter may kindly be send to the Department of Heavy Industry as early as possible positively within a month.

Encl: as above.

Yours faithfully,

  
(B.L. Kureel)

Under Secretary to the Govt. of India  
Phone : 2306 1738  
Fax:23061785

Minutes of the 1<sup>st</sup> Meeting of the reconstituted Development Council for Machine Tools Industry held on March 9, 2010 at 11.30 AM in Udyog Bhawan, New Delhi

The first Meeting of the reconstituted Development Council for Machine Tools Industry was held on 9<sup>th</sup> March, 2010 under the Chairmanship of Dr. Satyanarayana Dash, Secretary, Department of Heavy Industry. The list of participants is at **Annexure-I.**

2. Shri Harbhajan Singh, Joint Secretary, Department of Heavy Industry and Member-Secretary of the Council welcomed the participants and apprised them about the importance of a strong, well developed and modern Machine Tool Industry. He mentioned that the Indian Machine Tool Industry has a vast market but was facing number of constraints like non availability of appropriate technology, inadequate R&D investment, non availability of skilled manpower, competition from import of obsolete and cheap second hand machinery etc.

3. In his key note address, Dr. Satyanarayana Dash, Secretary (HI) and Chairman of the Council expressed happiness on the revival of the Development Council for Machine Tools Industry. While giving an overview, of the industry scenario, he apprised the members of the challenges lying ahead in the development of this sector. He mentioned that in the last meeting of promotion of machine tool industry held at NMCC in December, 2009, it was decided to set up a forum in the Department of Heavy Industry for interaction between machine tools manufacturers and users for preparation of action plan on all the issues pertaining to machine tool sector. He told that the Machine Tool Industry is the back bone of the engineering industry and need of the hour is to produce more efficient and reliable machines to meet the growing needs of the user industry. He drew attention of the participants to the down turn in the last year but expressed happiness on the improved IIP (CG) figure in the month of December, 2009 as compared to Decembers, 2008.

4. The Chairman drew attention of the meeting to the challenges especially in the area of research and development and stressed that the industry must identify the areas for R&D in the machine tool sector and then work together with academia and end users. He observed that that grey areas in the machine tools industry are technological up gradation, import of second hand machines, investment in R&D, availability of skilled manpower, inverted duty structure, exemption from payment of custom duty on strategic machine tools components, high rate of depreciation, lack of constitutional and financial support and suitable action plan to re structure HMT and HEC etc. The Chairman requested all the members of the Council to come up with suitable strategies to tackle these issues so that the sector develops in a substantial way. He also expressed surprise that no large industrial house of the country has ventured into the manufacture of machine tools. It was informed that, with the aim of providing much needed intervention in the enhancement of competitiveness in the capital goods sector, a scheme is under consideration to support 5 sectors including machine tools industry.

5. This was followed by a brief presentation by the Sh. V.C. Agrawal Industrial Adviser on the status of the industry including number of units, production of machine



tools, import & export statistics, policy provisions, challenges before the industry and initiatives taken by DHI.

6. Initiating the discussions, Sh. Lokeshwara Rao, President ITMMA, in response to the query of the Chairman, informed that large industrial houses did venture in this field but opted out due to non viability and returns on investment being low. He informed that foreign machine tools manufacturers get loans at the interest rate of 2% whereas it is 14% in India. He also told that this industry is considered high risk industry and is charged interest of 15% by Exim bank. He informed about the problems in getting 5 axis machines from Japan because it could be used for nuclear applications also. He suggested for setting up of Corpus funds of Rs. 500-1000 crores to give soft loans to the industry. This fund could be 50% contributed by the government and 50% by the industry and managed by any reputed financial institution like EXIM Bank, IDBI etc. The President, IMTMA informed that the industry should adopt polytechnic and IIT institutes through introduction of advanced curriculum based on latest technology in their area for development of skilled man power and there has been example in Andhra Pradesh to this effect.

7. Sh. Mohanram Technical Adviser to IMTMA made a presentation regarding the status of the industry. It was told that by 2020 the industry would require investment of Rs. 15000 crores so that the production can be increased to Rs. 28000 crores from the present level of Rs.3000 crores. He also informed that at present India's market share in the production of machine tools is 0.8% only.

8. Detailed discussions were held on several issues including constrained faced by machine tools industry sector. An important issue on which participants raised concern was on the availability of skilled man power. There is scarcity of qualified and experienced sales engineers also in this field. Representatives from SIAM informed that studies have been made on gap on skilled man power in many areas and there is need for similar studies in this sector also. The information available with him was provided to IMTMA to make further progress.

9. A mention was made that there is a need to formulate machine tool mission like auto mission made in the field of automobile industry. A need was also felt for closer interaction of machine tool industry with the user industry. Major sectors of the users of the machine tool like Automobiles, Railways, Defence etc. may be identified and on the basis of projections of the requirement of machine tool industry by these sectors in next five to ten years, the industry can develop its strategy.

10. Another important aspect on which the participants raised concern and was discussed at length related to the import of second hand machine tool without any age restriction. A view was expressed that there is no harm in import of second hand machine tools which are of large capacity and not manufactured in India and are available at cheap rate in international market. The counter view was the second hand machines will not have the latest technology as available in the new machine and may not result in the accuracy and tolerance required by the product made out of the machine. When the effort is to move to zero % rejection it may be preferred to import new machines even though at a higher cost. It was decided that some sample study may be made of the

import of second hand machines where they have not served their residual life. To the query of non availability of very large size machines, representatives of HEC informed that they are manufacturing and supplying very large machines to the industry.

11. With regard to the availability of critical inputs to this sector, it was informed that CNC system which is an integral part of most of the machine tools are manufactured by only two companies in the world viz. M/s Siemens Germany and Fanuc Japan. India has to pay higher price on import of this item as our requirement is very low. It was concluded that as a long term strategy, an R&D project should be taken up in this field.

12. The various issues deliberated in the meeting were summarized as follows:

- a. Creation of a corpus fund to provide soft loan to the industry
- b. Restricting the import of second hand machine tools.
- c. Identification of the gaps in availability of skilled man power.
- d. Programmes of Research & Development
- e. Preparation of a machine tool mission

13. It was decided that a sub committee of 5-6 members will be constituted to study the above issues and make recommendations to the Council within a month. Representatives of IMTMA agreed to give their nominations in this regard.

14. In his concluding remarks, The Chairman of the Development Council called upon the members to actively contribute to this sector development. The meeting concluded with a vote of thanks to the Chair.

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List of participants attended the First Meeting of Development Council for Machine Tool Industry held on 09.03.2010 (Room No.172 - Koustubham) Udyog Bhavan New Delhi

S. No.	Name & Designation
1.	Dr. Satyanarayan Dash, Secretary, Department of Heavy Industry – <b>In Chair</b>
2.	Shri Harbhajan Singh, Joint Secretary, DHI – <b>Member Secretary</b>
	<b>Members/Representatives of Members:</b>
3.	Mr. A. Komu, Addl. DGFT Director General of Foreign Trade(DGFT)
4.	Mr. Niranjan Naik, Addl. Industrial Adviser O/o Development Commissioner MSME
5.	Mr. Zubin Riaz, Under Secretary, Department of Revenue, Ministry of Finance
6.	Mr. P.R. Dalal, Executive Director EXIM Bank of India.
7.	Mr. P. Babin, Joint Director Central Manufacturing Technology Institute
8.	Mr. S.G. Roy, Director CII New Delhi
9.	Mr. Dilip Chenoy, Director General Society of Indian Automobiles Manufacturers (SIAM)
10.	Mr. Jitender Rana, Automotive Component Manufacturers Association of India
11.	Mr. M. Lokeshwara Rao, President, Indian Machine Tool Manufacturers Association (IMTMA)
12.	Mr. Vikram Sirur, Vice-President, Indian Machine Tools Manufacturers Association
13.	Mr. Srinivas G. Shirgurkar, Managing Director, Ace Designers Ltd.
14.	Mr. C.P. Rangachar, Managing Director, Yuken India Ltd.
15.	Mr. A.V. Kamat, CMD, HMT Ltd.
16.	Mr. V. Hemachandra Babu, Managing Director, HMT Machine Tools Ltd.
17.	Mr. Parakram G. Jadeja, Chairman & MD, Jyoti CNC Automation Pvt. Ltd.
18.	Dr. Ranjit Date, President & Jt. Managing Director, Precision Automation & Robotics India Ltd.
19.	Mr. G.K. Pillai, Chairman & MD, Heavy Engineering Corporation Ltd.
20.	Mr. Sanjay Desai, Sr. Dy. General Manager, Larsen & Toubro Ltd.
	<b>Invitees and Other Participants:</b>
20.	Mr. Satyam, Director, Central Manufacturing Technology Institute
21.	Mr. Mohanram, Sr. Director, Indian Machine Tools Manufacturers Association
22.	Mr. V. Anbu, Executive Director, Indian Machine Tools Manufacturers Association
23.	Mr. A.S. Pundle, Dy. Director, Indian Machine Tools Manufacturers Association
24.	Mr. Deepak Pandhi, Indian Machine Tools Manufacturers
25.	Ms. Subhag Naqvi, Automotive Component Manufacturers Associations of India
	<b>Participants from Department of Heavy Industry</b>
26.	Mr. V.C. Agrawal, Industrial Adviser
27.	Mr. N.L. Goswami, SrDO
28.	Mr. B.L. Kureel, Under Secretary

\*\*\*\*\*

Action Points arising out of the 1<sup>st</sup> Meeting of the reconstituted Development Council for Machine Tools Industry held on March 9, 2010 at 11.30 AM in Udyog Bhawan, New Delhi

1. All the members of the Council to come up actively to this sector for the development with suitable strategies and proposals and prepare an action plan which would help in tackling challenges and issues such as non availability of advanced technology, identification of the areas for R&D together with inadequate investment, non availability of skilled manpower, competition from import of obsolete and cheap second hand machinery, how to increase in the market share globally, investment requirement of Rs. 15000 crores by 2020, etc. It was also decided to set up a forum in the Department of Heavy Industry for interaction between machine tools manufacturers and users on all the issues pertaining to machine tool sector.

(Action: All members and IMTMA)

2. Identify and submit concrete and in-built proposals in the area of R&D together with academia and end users for the technological upgradation of machine tools sector. Also to identify and develop strategy on the basis of projections of the requirement of machine tools in next five to ten years.

(Action: IMTMA, Academia and End Users like Automobiles, Railways, Defence).

3. IMTMA to submit the details of import of second hand machinery, inverted duty structure, exemption from payment of customs duty on strategic machine tools components, high rate of depreciation, lack of constitutional and financial support at the earliest.

(Action: IMTMA).

4. Submit a proposal for suitable action plan to re structure HMT and HEC.

(Action: IMTMA, HMT, HEC)

5. IMTMA to find out the reasons for no large industrial house of the country has ventured and willing to venture into the manufacture of machine tools.

(Action: IMTMA)

6. Government has already provided a much needed platform and scheme in the enhancement of competitiveness in the capital goods sector which includes machine tools sector also. With a view to prepare a scheme of machinery manufacturers on friendly and self sustainable basis, IMTMA to submit a comprehensive proposal for setting up Common Facility Centres, Capacity Building Support (business development services, market development support, skill development support), Development of Integrated Cluster Parks, Support to R&D projects, etc.

(Action: IMTMA)

7. For setting up of Corpus funds of Rs. 500-1000 crores to give soft loans to the industry a detailed proposal containing all relevant aspects may be submitted at the earliest.



(Action: IMTMA & EXIM Bank of India)

8. To find a solution to the problems in getting 5 axis machines from Japan because of nuclear applications, a write-up may be submitted at the earliest.

(Action: IMTMA)

9. For adopting action plan in the polytechnic and IIT institutes through introduction of advanced curriculum based on latest technology for development of skilled manpower, a suitable proposal may be prepared by IMTMA. Also considering there is an acute shortage of qualified and experienced sales engineers in this field, IMTMA and SIAM to submit the detailed action plan by identifying skill gap analysis by 2020 as similar action taken in the past by auto industry.

(Action: IMTMA & SIAM)

10. Mr. Mohanram of IMTMA to submit the plan papers on formulation of machine tool mission.

(Action: Mr. Mohanram of IMTMA)

11. A comprehensive report to be submitted on import of second hand machine tool without any age restriction by undertaking sample study of such second hand machines, if any, where they have not served their residual life.

(Action: IMTMA, SIAM & End Users)

12. As CNC system which is an integral part of most of the machine tools are manufactured by only two companies in the world viz. M/s Siemens Germany and Fanuc Japan. India has to pay higher price on import of this system as the requirement is very low. It was concluded that as a long term strategy, an R&D project should be taken up in this field. A detailed plan paper to be submitted to solve the problem by IMTMA & HMT.

(Action: IMTMA, HMT)

13. IMTMA to suggest the names immediately for making sub committee of 5-6 members which will be constituted to study the above mentioned issues and make recommendations of all above issues to the Council within a month.

(Action: IMTMA)

*Reply to the above action points may be sent within a month.*

\*\*\*\*\*

## Annexure 2: DHI: Constitution of the sub-committee

No. 1/2/2009-HE&MT  
Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
(HE&MT Section)

Udyog Bhavan, New Delhi  
Dated, the 19<sup>th</sup> April 2010.

Subject:-Constitution of the Sub-committee/Task Force to the Reconstituted Development Council for Machine Tool Industry.

Pursuant to the action point no. 13 arising out of the 1<sup>st</sup> meeting of the reconstituted Development Council for Machine Tool Industry held on 09.03.2010 at Udyog Bhavan, New Delhi, under the Chairmanship of Secretary (HI) and with the approval of competent authority, a sub-committee/task force comprising of the following has been constituted -

- |  |            |
|--|------------|
| 1. Shri M. Lokeswara Rao, President-IMTMA  | - Convener |
| 2. Shri S G Shirgurkar, MD, Ace Designers Ltd.                                     | -Member    |
| 3. Shri Shailesh Sheth, Corporate Advisor  | - Member   |
| 4. Shri C.P. Rangachar, MD, Yuken India Ltd.                                       | - Member   |
| 5. Shri A P Arya, MD, TAL Manufacturing Solutions Ltd.                             | -Member    |
| 6. Dr. Ranjit Date, President & Jt. MD, Precision Automation & Robotics India Ltd. | - Member   |
| 7. Shri V. Hemachandra Babu, MD, HMT Machine Tools Ltd.                            | - Member   |
| 8. Shri G.K.Pillai, CMD, HEC   | -Member    |

The above-mentioned sub-committee/task force will study various issues relating to the Machine Tools Industry discussed in the meeting of the Development Council held on 09.03.2010 and make suitable recommendations of all issues to the Council within a month.

(B.L. Kureel)  
Under Secretary to the Govt. of India  
Phone: 2306 1738 Fax: 23061785

To: S/Shri (S.No. 1 to 8)

For information to-  
PS to JS (H),  
PS to Dir (VP), IA (SL)  
Shri V Anbu, Executive Director, IMTMA, Bangalore.



## Annexure 3: Programme Advisory Committee for R&D in Machine Tools: Office Memo by PSA's Office

F.No.: Prn.SA/MT/2005  
GOVERNMENT OF INDIA  
OFFICE OF THE PRINCIPAL SCIENTIFIC ADVISER  
TO THE GOVERNMENT OF INDIA

326, Vigyan Bhawan Annexe  
Maulana Azad Road  
New Delhi – 110 011  
Tel. No.: 011-2302 2091  
: 011-2302 2115  
Fax No. : 011-2302 2113  
: 011-2302 2116  
E-mail: [npsa@nic.in](mailto:npsa@nic.in)  
[nprnsa@gmail.com](mailto:nprnsa@gmail.com)

Dated: 30<sup>th</sup> June, 2009

### OFFICE MEMORANDUM

**Sub: Re-constitution of the Programme Advisory Committee for Research & Development in the Machine Tools Sector – regarding.**

In continuation of this Office's Office Memoranda of even number dated the 20<sup>th</sup> of April, 2006 and the 31<sup>st</sup> of October, 2007, the undersigned has been directed to convey the decision of the Government of India to re-constitute the Programme Advisory Committee (PAC) for Research and Development in the Machine Tools Sector w.e.f. the date of issue of this Office Memorandum.

2. The following will be the Composition and the Terms of Reference of the re-constituted PAC.

#### 2.1 Composition:

S. No.	Name, Designation & Organization	Status
(i)	Dr. P. Radhakrishnan, Former Vice Chancellor, Vellore Institute of Technology, Vellore and, currently, Director, PSG Institute of Advance Studies, P.O. number 1609, Avinashi Road, Coimbatore – 641 004.	Chairman
(ii)	Shri N.K. Dhand, Chairman and Managing Director, Micromatic Grinding Technologies Limited, C-27 and 28, Meerut Road, Industrial Area, Ghaziabad – 201 003.	Co-Chairman
(iii)	Managing Director, HMT Machine Tools Limited, "HMT Bhavan", 59 Bellary Road, Bangalore – 560 032.	Member
(iv)	Dr. S. Mohan, Professor, Department of Instrumentation, Indian Institute of Science, Bangalore – 560 012.	Member
(v)	Shri P.J. Mohanram, Senior Adviser-Technology, Indian Machine Tool Manufacturers' Association, 10 <sup>th</sup> Mile, Tumkur Road, Madavara Post, Bangalore – 562 123.	Member
(vi)	Shri B.R. Satyan, Director, Central Manufacturing Technology Institute, Turmukur Road, Bangalore – 560 022.	Member
(vii)	Dr. N. K. Mehta, Professor, Department of Mechanical Engineering, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand – 247 667.	Member
(viii)	Dr. P. Venkateswara Rao, Professor, Department of Mechanical Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi – 110 016.	Member
(ix)	Dr. A. K. Chattopadhyay, Professor and Head, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, Kharagpur – 721 302.	Member

Contd...2...

(x)	<b>Shri Sushil Lakra</b> , Industrial Adviser, Department of Heavy Industry, Ministry of Heavy Industries & Public Enterprises, Room number 474-A, Udyog Bhawan, Maulana Azad Road, New Delhi - 110 011.	<b>Member</b>
(xi)	<b>Shri C.K. Viswanathan</b> , Director (Mechanical), Ministry of Micro, Small and Medium Enterprises, Room number 714, 7 <sup>th</sup> Floor, Udyog Bhawan, Maulana Azad Road, New Delhi – 110 011.	<b>Member</b>
(xii)	<b>Shri A.P. Arya</b> , Managing Director, TAL Manufacturing Solutions Ltd., TATA Motors Campus, Chinchwad, Pune – 411 033.	<b>Member</b>
(xiii)	<b>Shri P.V.N. Sanjay</b> , Chief Executive Officer, Machine Tool Division, Batliboi Ltd., Ground Floor, Great Western Building, 130/132, Shaheed Bhagat Singh Marg, Fort, Mumbai – 400 023.	<b>Member</b>
(xiv)	<b>Shri Shrinivas G. Shirgurkar</b> , Managing Director, Ace Designers Limited, Plot No. 7 & 8, Phase-II, Peenya Industrial Area, Bangalore – 560 058.	<b>Member</b>
(xv)	<b>Shri Parakram G. Jadeja</b> , Chairman and Managing Director, Jyoti CNC Automation Private Limited, G-506, Lodhika, G.I.D.C., Village Metoda, District Rajkot – 360 021.	<b>Member</b>
(xvi)	<b>Shri Deepak S. Shrivastava</b> , Chief Executive Officer, Electronic Machine Tools Ltd., Elektra House, 691/1A, Pune Satara Road, Pune – 411 037.	<b>Member</b>
(xvii)	<b>Shri C.P. Rangachar</b> , Managing Director, Yuken India Limited, P.O. Box number 16, Parallel – II, Brigade Park, Whitefield Road, Whitefield, Bangalore – 560 066.	<b>Member</b>
(xviii)	<b>Shri Rakesh Kumar Singh</b> , Managing Director, SRB Machines Pvt. Ltd., 59/2/1, Site-IV, Industrial Area, Sahibabad, Ghaziabad – 201 001.	<b>Member</b>
(xix)	<b>Shri Shailesh D. Kawa</b> , President, Rajkot Machine Tool Manufacturers' Association, 44, Shivanda Complex, Dhebar Road, Rajkot – 360 002.	<b>Member</b>
(xx)	<b>Shri Neeraj Sinha</b> , Scientist 'E', Office of the Principal Scientific Adviser to the Government of India, 326, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi 110 011.	<b>Member-Secretary</b>

## 2.2 **Terms of Reference:**

- (i) The Committee shall develop, within the next 5 months, a Technology Road Map for the country's Machine Tools sector, identifying the thrust areas for Research and Development in that sector.
- (ii) The Committee will critically examine the technology gaps in the Machine Tools sector in the said Road Map.
- (iii) The Committee will generate project proposals and recommend specific intervention programmes in the short and long term.
- (iv) The Committee will identify individuals / groups and institutions, with core competence, who can be invited to take up project proposals as per the prioritized needs.
- (v) The Committee will recommend inter-institutional collaboration, if necessary, to ensure that all possible expertise available in the country is optimally utilized.
- (vi) The Committee will facilitate involvement of industry / industries concerned for each project and encourage collaborative participation of industry and research organizations / institutions, in a consortium mode, right from the initiation of the project.

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(vii) The Committee will evaluate each project proposal and, based on the merit of the proposal, recommend the same for financial support. In doing so, the Committee will review the status of work already done by research institutions so that results of such developments could be incorporated in the projects recommended.

(viii) The Committee will evolve a system of evaluation of the projects which should be easy to operate and not prolonged / time consuming.

(ix) The Committee may invite, as special invitees, experts from the academia or the industry for discussion and special inputs during any of its meetings.

(x) The Committee will help in the setting-up of Project Review and Monitoring Committees (PRMCs) to closely monitor and evaluate the progress of each project / group of projects that gets sanctioned.

(xi) The Committee will recommend small research projects, to be taken-up as subsets of the main projects, which may be necessary for providing important inputs for the successful completion of the main projects.

(xii) The Committee will recommend market surveys, study visits and participation in international workshops for enrichment of the research and development programme.

(xiii) The Chairman of the Committee shall have the authority to co-opt members as and when required, and shall also have the authority to call for emergency meetings of the Committee, even when they are not due.

(xiv) The traveling and daily allowances will be payable, as per the existing rules of the Government of India, to the non-official constituents, if any, of the Committee.

(xv) The Chairman and the members of the Committee shall be eligible for the payment of an honorarium of Rs. 1000/- per head for each day of meeting attended.

(xvi) The Committee will have a term of 3 years from the date of issue of the Office Memorandum notifying its constitution. It will be expected to meet once in every quarter.

3. This issues with the approval of the Principal Scientific Adviser to the Government of India.

  
(NEERAJ SINHA)  
SCIENTIST 'E'

and Member-Secretary to the PAC

To:

1. **Dr. P. Radhakrishnan**, Former Vice Chancellor, Vellore Institute of Technology, Vellore and, currently, Director, PSG Institute of Advance Studies, P.O. number 1609, Avinashi Road, Coimbatore – 641 004.
2. **Shri N.K. Dhand**, Chairman and Managing Director, Micromatic Grinding Technologies Limited, C-27 and 28, Meerut Road, Industrial Area, Ghaziabad – 201 003.
3. **Managing Director**, HMT Machine Tools Limited, 59 Bellary Road, Bangalore – 560 032.
4. **Dr. S. Mohan**, Professor, Department of Instrumentation, Indian Institute of Science, Bangalore – 560 012.
5. **Shri P.J. Mohanram**, Senior Adviser-Technology, Indian Machine Tool Manufacturers' Association, 10<sup>th</sup> Mile, Tumkur Road, Madavara Post, Bangalore – 562 123.

Contd...4...

6. **Shri B.R. Satyan**, Director, Central Manufacturing Technology Institute, Turmkur Road, Bangalore – 560 022.
7. **Dr. N. K. Mehta**, Professor, Department of Mechanical Engineering, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand – 247 667.
8. **Dr. P. Venkateswara Rao**, Professor, Department of Mechanical Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi – 110 066.
9. **Dr. A. K. Chattopadhyay**, Professor and Head, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, Kharagpur – 721 302.
10. **Shri Sushil Lakra**, Industrial Adviser, Ministry of Heavy Industries & Public Enterprises, Department of Heavy Industry, Room number 474-A, Udyog Bhawan, Maulana Azad Road, New Delhi 110 107.
11. **Shri C.K. Viswanathan**, Director (Mechanical), Ministry of Micro, Small and Medium Enterprises, Room number 714, 7<sup>th</sup> Floor, Nirman Bhawan, Maulana Azad Road, New Delhi – 110 108.
12. **Shri A.P. Arya**, Managing Director, TAL Manufacturing Solutions Ltd. TATA Motors Campus, Chinchwad, Pune – 411 033.
13. **Shri P.V.N. Sanjay**, Chief Executive Officer, Machine Tool Division, Batliboi Ltd., Ground Floor, Great Western Building, 130/132, Shaheed Bhagat Singh Marg, Fort, Mumbai – 400 023.
14. **Shri Shrinivas G. Shirgurkar**, Managing Director, Ace Designers Limited, Plot No. 7 & 8, Phase-II, Peenya Industrial Area, Bangalore – 560 058.
15. **Shri Parakram G. Jadeja**, Chairman and Managing Director, Jyoti CNC Automation Private Limited, G-506, Lodhika, G.I.D.C., Village Metoda, District Rajkot – 360 021.
16. **Shri Deepak S. Shrivastava**, Chief Executive Officer, Electronic Machine Tools Ltd., Elektra House, 691/1A, Pune Satara Road, Pune – 411 037.
17. **Shri C.P. Rangachar**, Managing Director, Yuken India Limited, P.O. Box number 16, Parallel – II, Brigade Park, Whitefield Road, Whitefield, Bangalore – 560 066.
18. **Shri Rakesh Kumar Singh**, Managing Director, SRB Machines Pvt. Ltd., 59/2/1, Site-IV, Industrial Area, Sahibabad, Ghaziabad – 201 001.
19. **Shri Shailesh D. Kawa**, President, Rajkot Machine Tool Manufacturers' Association, 44, Shivanda Complex, Dhebar Road, Rajkot – 360 002.

**Copy to:-**

1. **Dr. R. Chidambaram**, Principal Scientific Adviser to the Government of India, 318, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi – 110 011.
2. **Dr. S.N. Dash**, Secretary, Department of Heavy Industry, Ministry of Heavy Industries & Public Enterprises, Room number 178, Udyog Bhawan, Maulana Azad Road, New Delhi – 110 011.
3. **Shri Dinesh Rai**, Secretary, Ministry of Micro, Small and Medium Enterprises, Room number 169, Udyog Bhawan, Maulana Azad Road, New Delhi – 110 011.

  
(NEERAJ SINHA)

## Annexure 4: Roadmap for the machine tool industry

### Indian Machine Tool Manufacturers' Association

## **A Roadmap for the Indian Machine Tool Industry (Feb. 2010)**

### **Introduction:**

The machine tool industry is the basic industry that supports all manufacturing industries. For this reason it is often called the “mother industry”. Its products, machine tools, are the “mother machines that build all other machines”. Throughout the industrialized world machine tools are recognized as a strategic industry for defence, aerospace and other security preparedness. The situation is no different in India.

NMCC has brought out the importance of the Indian machine tool industry to support the country's manufacturing growth ambitions, and pointed out its importance for defence related industries. The machine tool industry has been classified as a “strategic industry” by the PMO, which has asked the NMCC to work out a development plan for the industry to meet future requirements of the country for advanced manufacturing technology.

This paper presents a roadmap for the development and growth of the Indian machine tool industry.

### **1. Present position of the industry:**

The present position of the industry can be summarized as follows:

- a. Size (annual turnover): Rs.2000 cr (organized sector) + est. Rs.1000 cr (Unorganized); Total Rs.3000 cr
- b. Position: 18<sup>th</sup> place in world production; around 1% of world production (\$ 85 bn)
- c. Position: India is 9<sup>th</sup> place in world consumption at Rs.9000 cr (still only 10% of China's)
- d. Domestic market share: around 20-25%
- e. Exports: At 5-7%, negligible. No global size companies, although some have foreign offices.
- f. Technology: Strong in design; low R&D; substantial technology gaps
- g. Composition (by turnover): Around 8-10 large companies (Rs.100 cr, 10-15 medium Rs.50-100 cr and rest small); two PSUs, rest private companies.

Foreign presence: Growing rapidly. Leading international machine tool companies have set up technical centres and in some cases manufacturing units in India to capture the large markets for machine tools. Examples: DMG (Germany), Mazak, Makino, Fanuc, Mori Siki, (Japan) etc. A large number of others market through Indian agents and distributors.

### **2. Products:**

The Indian machine tool industry has a history of over 80 years, having been started by pioneers like Walchand and Kirloskar who set up the first units in India. The establishment of HMT in the 1950s by the government gave major fillip to the growth of the industry.

Through product collaborations in the 50s, 60s and 70s as well as a sustained effort at developing new products from the 1960s onwards, the industry has reached a level of maturity in being able to meet a



good part of industry requirements for machine tools. The Indian machine tool industry has the following product range in its manufacture:

- a. Manual general purpose machines all types
  - b. CNC machines (turning, machining, grinding)
  - c. Gear cutting \*\*
  - d. Large machines (boring, vertical turning) \*\*
  - e. Electrodischarge machines
  - f. Measuring machines and metrology equipment
  - g. Robots and automation \*\*
  - h. Laser based machines \*\*
  - i. Special Purpose Machines
  - j. Metalforming presses (Mechanical, Hydraulic, Servo)
  - k. Press Brakes, Shearing Machines, Punch presses
  - l. Pipe bending and forming machines
  - m. Hydroforming Machines\*\*
  - n. Forging Hammers
- \*\* (Limited manufacture)

### **3. Market and user industries:**

Across the world, machine tool industry serves all manufacturing industries. However, the major users are traditionally the automobile (transport) and defence related industries. The situation is similar in India. The rapid increase in demand for machine tools from 2000 onwards has been propelled primarily by demand from the Indian auto industry, and this is also responsible for the increase in imports seen in recent years. The approximate user segmentation of the Indian machine tool industry is given below:

- a. Auto (mostly auto component) .....40%
- b. Die and mould .....10%
- c. Textile, food processing, durables, electrical, furniture, office equipment, ...10%
- d. Industrial machinery .....20%
- e. Defence } .....5%
- f. Railways }
- g. Power }
- h. Nuclear }
- i. Others .....15%

### **4. Major technology gaps:**

Despite its strong design capabilities built up over the last 40-50 years, the Indian machine tool industry still faces technology gaps in meeting advanced requirements of machine tools and manufacturing technology by user industries. The machine tool industry is also handicapped by the non-availability of critical mechanical elements for machine tools, and the entire machine tool electronics for CNC machines. This poses a potential threat to the industry's long-term prospects. The machine tool industry has also faced technology denial from advanced countries, being refused the export of high precision and multi-axes machine tools from countries like Germany and Japan.

The technology gaps faced by the industry are listed as below:

- a. High speed, high productivity machines
- b. Multi axes, multi function machines

- c. High precision machines
- d. High tech surface finishing, honing, lapping
- e. Gear/thread/spline grinding
- f. Machines for semi-conductor industry
- g. Micro machining systems
- h. Large machines for strategic/infrastructure industry sectors
- i. New metal forming machines and technology
- j. All critical mechanical elements for CNC machine tools (now imported)
- k. Servo motors, drives and CNC controllers (Machine Tool Electronics, imported)
- l. Several sub-systems for machine tools (now imported)
- m. Foundry technology, alternate materials etc.

This is a potential strategic weakness for the country. Technology denial is faced by strategic sectors and even the machine tool industry. As a result, long-term manufacturing technology security is compromised.

### **5. Nature of the Indian machine tool industry:**

The machine tool industry is characterized by certain attributes, which have a bearing on investments, profitability and sustainability. Historically, machine tool companies were parts of either large automobile corporations or armament companies and served their requirements. In the process, the machine tool industry developed new technologies, which were also marketed to other user industries.

In India, machine tool companies are stand-alone entities. This poses serious financial handicaps and low interest from large corporations. Thus new investments have been few, either Greenfield or for modernization. The main features of the Indian machine tool industry are as follows:

- a. High investment required to create new capacities}
- b. Long gestation and payback period }
- c. Low profitability } discourages investment
- d. High interest rates }
- e. Still, some new investment made in recent years (Jyoti, MGTL, Ace, Premier )
- f. Collaborations/JVs ended, with free entry of foreign companies
- g. Foreign presence increasing rapidly

However,

- h. Most units need modernization in plant and machinery
- i. New technology infusion urgently required both in products and manufacturing

### **6. Roadmap for the growth of the industry:**

The machine tool industry having been recognized as a strategic industry needs to have a clear and firm roadmap for its long-term development. This should include the following major components:

- a. Technology development,
- b. Product development and
- c. Critical elements+machine tool electronics development
- d. Create world class capacities in machine tool manufacture
- e. Develop markets both domestic and abroad
- f. Place the industry on the world map as a significant player

While these are the desired objectives, the routes to achieve these have to be placed on a holistic, national perspective. In this, we cannot do better than take a lead from China, which has recently enunciated its policy for the development of its machine tool industry as part of its 11<sup>th</sup> 5-Year Plan in its S&T component (see Annexure 1). If a similar national mission for the Indian machine tool industry can be set down, the individual development components can flow from it logically.

Some of the measures that are necessary are as follows:

- a. Define a National Mission for Machine Tools (similar to China)
- b. Introduce immediate fiscal incentives
- c. Mission to indigenize critical mechanical elements and machine tool electronics
- d. Measures to attract investment are a priority
- e. Creation of modern state of the art capacities
- f. Realize full potential of PSU capacities
- g. Fillip to R&D and technology development is essential
- h. Industry-academia-R&D linkages

## 7. A scenario for the industry by 2020

A likely scenario (target) in 10 yrs (2020) is presented in the Table. The growth of the Indian machine tool industry is closely linked to the growth of the manufacturing sector of the economy. It is assumed that manufacturing growth will be at 15% + in the next decade.

Head	2010	2020 Realistic	2020 Ambitious	Remarks
World machine tool prodn. \$ bn	85	200	-----	Rs 380k cr. & Rs.900k cr (@ 10% CAG)
India consumption (Rs cr)	9000	36000	55000	15%/20%; mfg @ 15% +
India production (Rs Cr)	3000	12000	28000	@15, 25 % CAG. <b>Needs fresh investment</b>
Domestic share	33%	33%	51%	<b>Can drop if no fresh investment is made</b>
India share of world prodn	0.8%	1.3 %	3 %	

It can be seen that even with a 25% CAGR the Indian machine tool industry will just reach 3% of world production and raise its domestic market share to 50%. Therefore, it is obvious that the industry must target a high growth rate, which in turn requires R&D, capacity creation on a large scale not attempted hereto.

## 8. Measures for the growth of the Indian Machine Tool Industry:

If the performance levels set down above are to be achieved, then the inputs to the industry will have to be along the following lines:

- a. Defining the Mission: It would be best to set down a National Mission for Machine Tools, which should be anchored on the twin objectives of raising manufacturing growth in the country and securing manufacturing technology security for our strategic sectors.
- b. Fiscal incentives:  
Introduce immediate measures mainly in the form of fiscal incentives to stimulate demand and make machine tools cheaper and affordable to a larger section of users, especially SMEs. These measures are given in Annexure 2.

**c. Support measures:**

Approve and announce support measures for CG industry which includes the machine tool industry. These were evolved through a study by CII and then vetted by IL&FS for the DHI. The support measures finalized in 2007 are awaiting approval for implementation.

The measures include support for technology transfer, common facilities, R&D/Incubation centres, business & Market development and cluster parks. The total outlay was estimated at around Rs. 570 cr of which 50% was to be invested by the industry.

It may be necessary to revisit the extent of support measures to match future scenarios for the industry set down above in Para 7.

**d. Attract investment to the industry:**

This is crucial if the turnover of the industry has to be raised substantially. It is necessary to make machine tools less expensive to buyers, so increasing demand and stimulating creation of additional capacity. Measures could include:

- i. Keeping excise duty on machines at 8% (if not lower)
- ii. Allow higher depreciation so machine tools can be written off in 4 years
- iii. Designate machine tools as priority sector for lending, with concessional interest rates
- iv. Excise duty exemptions for SMEs and non excise paying units
- v. Extend tax holidays and other concessions for new investments or substantial expansions in machine tools

From the foregoing, it can be seen that for the industry to grow from its present level of Rs.3000 cr to the ambitious growth target of Rs.55000 cr (sec.7 above), the industry will require around Rs.15000 cr investment. Investment levels of this order will require financial support on a larger level, to meet clearly set down long term goals. Investment from Indian machine tool units, the government, through part privatization of PSU and potential joint venture partners may be considered as sources for such investment.

The flip side is that if this investment does not take place, the domestic industry will entirely lose out to imports, and the domestic market share could drop to 10% or so, with serious consequences.

**e. Realize full potential of PSU units:**

The industry has two large PSU units: HMT Machine Tools and Heavy Machine Tools Plant, Ranchi which is a part of HEC. Together, these PSU units have the potential for a turnover of Rs.1000 cr or more by modern standards. For this, it is necessary to restructure these units with privatization to at least 50% and make these totally board managed companies.

Both companies have a good heritage of machine tool technology and manufacturing capacities, but require physical and manpower modernization to take up modern products and technologies for the future.

This is of course a major component which requires a deeper study to work out the details of restructuring these companies.

**f. Product and technology development, R&D:**

A major concern is the technology gaps and how to bridge them. This requires a multi-pronged strategy:

- i. Strengthen Central Manufacturing Techniology Institute (CMTI) and make it autonomous. While CMTI can pursue its development for other, especially strategic sectors, it must establish a separate vertical for machine tool R&D. Programs with priorities can be worked out for implementation to meet the roadmap objectives. Funding for critical projects must flow from government.
- ii. To strengthen regional machine tool clusters, two or three more institutions similar to CMTI are required in the west and north of the country.
- iii. Start Engg. Colleges Dev. program where funds up to say, Rs.10 Cr are sanctioned for setting up R&D labs. , B. Tech. & M. Tech. program in Machine Tool Technology in association with a local MT Industry.
- iv. Employ a National Mission mode R&D and manufacture of critical mechanical elements and machine tool electronics. This will be an industry-academia-R&D consortium program involving several organizations with specialized skills to realize its objectives.
- v. Large government organizations like DGOF, Railways, DAE, BHEL, which require special machines (including large machine tools) may give development contract to Indian machine tool companies for their requirements. This is a sure route to development of higher technology and capabilities, followed in all developed countries routinely.
- vi. Likewise, these institutions may be mandated to insist on Indian partners for imported machines, and local value addition. *This will counter technology denials and ensure manufacturing technology security for the country.*

**g. Acquisition as strategy:**

Machine tool technology has developed extensively. Foreign companies have established Indian offices/units to cater to our requirements. There is no incentive for collaborations with Indian companies or other forms of technology transfer/JV etc. So the Indian machine tool industry has no means of accessing latest technologies.

India could follow the Chinese strategy. China is systematically buying renowned machine tool companies in Europe to acquire technology and markets. This is a part of their strategy to develop capabilities to build latest technology machines and reduce dependence on imports by 2010.

**h. Skill development:**

Establish a National Centre for Manufacturing Excellence and Innovation to train and develop technical and managerial professionals at all levels for industry, both machine tools and user industries in manufacturing. (Develop NMCC-CII VLFM initiative)

The complete set of measures, both immediate and medium-term are summarized in Annexure 2.

#### 9. **Suggested course of action:**

NMCC during a meeting with the machine tool industry, users and the concerned government departments had suggested the constitution of a group of stake holders to identify measures required for the growth of the machine tool sector.

It is suggested that an Empowered Task Group may be formed under NMCC with representation from Planning Commission, Dept. of Heavy Industry, major user sectors and the machine tool industry to give detailed shape to the roadmap and make specific recommendations on the measures for the growth and development of the industry.



February 2010

## **China Sets Sights On Machine Tool Development**

Bruce Vernyi

A report released recently from China cited the internal development of precision CNC machine tools as one of the country's strategic needs and targets over the next 15 years. China currently is the largest machine tool consumer in the world.

The government-issued report, titled "Outline of the National Medium-and Long-term Planning for Development of Science and Technology (From 2006 to 2020)," identifies manufacturing as one of 11 major sectors of development China intends to pursue in the next 15 years, and specifically cited the domestic production of precision machine tools as one of 16 core projects in science and technology chosen for growth.

The report indicates China's intention to emphasize the development of CNC control systems that will be designed for the machine tools. Also, the document notes plans to develop additional equipment, such as high-speed spindles, and the ancillary equipment needed for the machine tools, such as ball screws, robotic tool holders and tool-changing magazines, rotary tables, linear guided motors, and toolholding devices. The report was made available by China's official news agency in February.

Additionally, China's government identified its desire to produce high precision machine tools in two other recent reports.

Last September, a Chinese government document stated that China should reduce its reliance on imported CNC machine tools by developing its own machine tools and computer control systems.

Later, in its "Eleventh Five-year Plan period from 2006 to 2010," the Chinese government identified types of machine tools that it plans to build domestically over the next five years.

The machine tools identified in the plan include high-speed, high-precision CNC lathes and turning centers; four-axis machining centers; high-speed, high-precision vertical machining centers; CNC boring and milling centers; a variety of heavy-duty CNC machine tools; ultra high precision CNC grinding machines, including crankshaft and specialized grinding machines; wire EDM machines, including large, CNC EDM machines; metal forming machines; and automatic and specialized production machines. The five-year plan also was published in English by China's official news agency.

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## **Indian Machine Tool Manufacturers' Association**

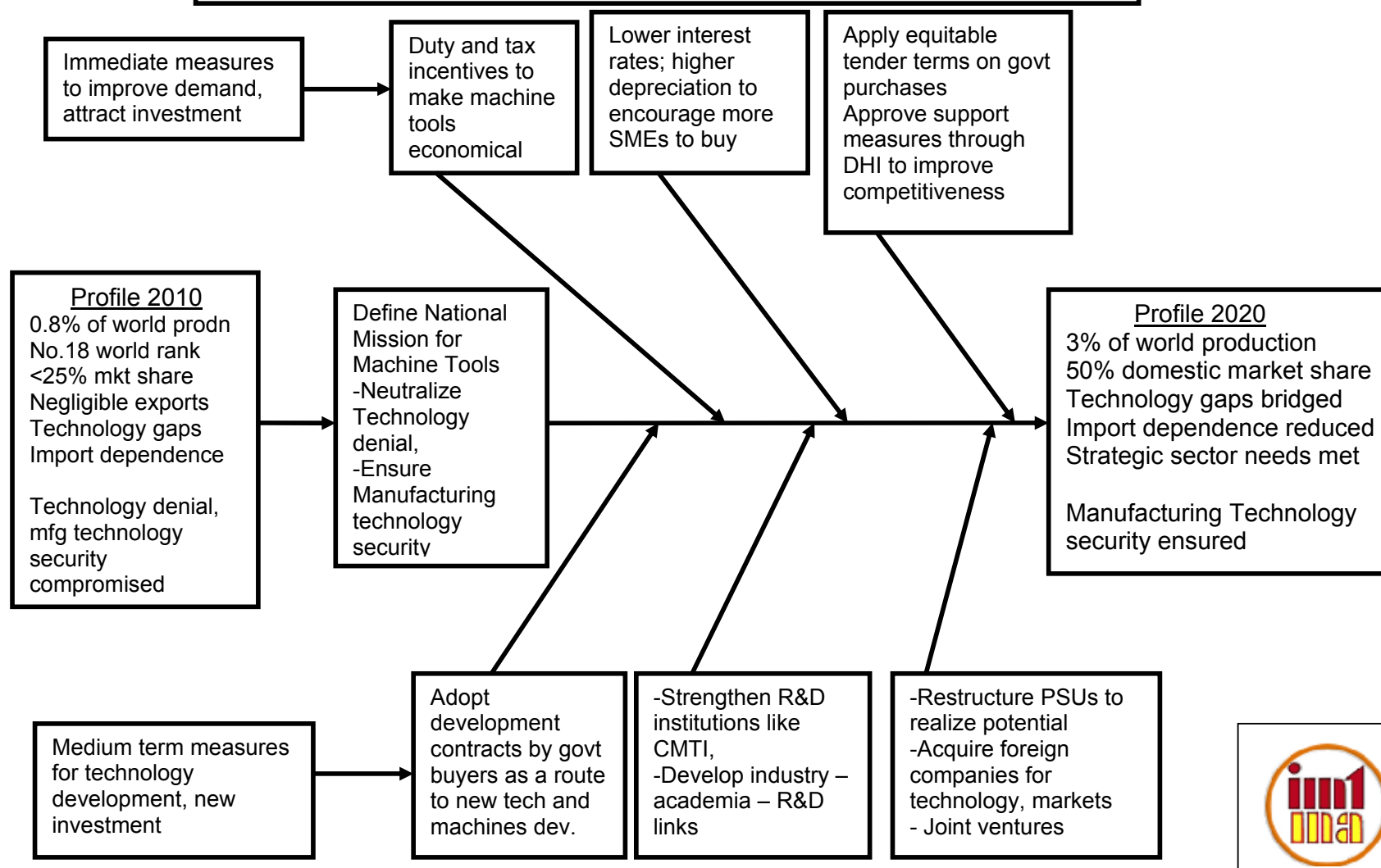
### **Support measures for the development of the Indian Machine Tool Industry**

	<b><u>Issue</u></b>	<b><u>Measures suggested</u></b>	<b><u>Remarks</u></b>
	<b><u>Immediate measures which can be introduced with the 2010 budget / during 2010-11</u></b>		
1	Reduce cost of machine tools	Reduce custom duty on following components not manufactured in India from the existing level of 7.5% to Nil. CNC Systems covered under tariff head 85.37 , Servo Drives/Motors under tariff head 85.01 or 85.04, Precision Spindles covered under tariff head 846693, Ball Screws covered under tariff head 8483, LM Guide ways covered under tariff head 848280, Precision Bearings covered under tariff head 8482, Precision Gauging/Balancing System 903180 or 9016	This is to correct the inverted duty structure existing at present, by which finished machines and components for machine tools suffer the same duty. If implemented this will make machine tools less expensive to users and will spur demand.
2	Reduce cost of machine tools	Excise Duty on machine tools which was reduced from 14% to 8% as part of the stimulus plan may be retained at 8% in the future	Being basic capital goods used in all industries, this will spur demand, reduce cost to industry.
3	Reduce cost of machine tools	At present machine tool mfg companies sourcing inputs from non-excise units do not get MODVAT credit on excise duty paid on inputs by such units, leading to increase in machine tool price.	A system of "pass through" MODVAT will allow larger units to get credit on excise duty paid on inputs by non-excise units. Reduces cost.
4	Reduce cost of machine tools and spur demand	Small Scale Industry can be given loan for 5 years at easy interest rates for installing CNC Machines through nationalized banks as well as other lending institutions.	Help SMEs acquire latest technology machine tools, reduce cost of mfg, improve manufacturing quality and competitiveness
5	Reduce cost of machine tools and spur demand	For small scale manufacturers and job shops that do not pay excise duty on their terminal products, Excise duty on machine tools may be exempted or reimbursed	Reduce capital cost to such industries in the SME sector with benefits as above.
6	Reduce cost of machine tools	Remove the cess on import of technology by Indian companies	This pushes cost of technology acquisition, especially as such costs are already high
7	Spur demand for new machines, protect against obsolete technology	Used machine import: Restrict import of used machines under OGL to only those which are less than 7 years old and cif value more than Rs 50 lakhs	To safeguard mfg industry from obsolete technology; safeguard machine tool industry against indiscriminate imports, while still allowing legitimate needs.
8	Spur demand for new machines	Allowing higher rate of depreciation on machine tools so that entire cost of the procurement is written off in about 4-5 years	Modern CNC machines have a design life of 5-7 years max., and rapid obsolescence. This measure will permit constant technology upgradation and quality improvement in mfg.

9	Finance and working capital difficult to obtain	Treat machine tools as “priority sector” for financing; currently treated as “risky sector”. Apply lower interest rates to attract investment.	To encourage banks/FIs to lend to machine tool industries. (Foreign companies offer deferred payment terms at very low interest rate, making imports attractive)
10	Inequities in tender terms	Offer same terms to Indian machine tool companies as for imports, in government tenders (Railways, DGOF, BHEL, PSUs etc) Also relax conditions of “previous supply”	Present terms are highly disadvantageous to domestic machine tool companies.
11	Disadvantages against imports	Remove the provision for zero duty imports for projects	This puts the domestic industry under disadvantage in price competitiveness.
12	Disadvantages against imports	Do not include machine tools for concessional duty imports in the FTAs, especially in cases where the other country has a strong machine tool industry (e.g. Europe) or such country does not import machine tools significantly.	This puts the domestic industry under disadvantage in price competitiveness against imports from such countries.
13	Acquiring technology	Insist on Indian Partner on all machine tool imports by government sectors	Facilitates technology transfer, cost reduction and availability of spares and service to users
14	Acquiring technology	Introducing offset clause on machine tool imports of more than say Rs 10 Crores	Force foreign companies to transfer technology and reduce cost; adopted by China rigorously
15	Put machine tool industry on development path Attract investment	Approve and announce support measures for the CG industry, of which machine tool industry is one.  Adopt mission mode development of critical mechanical elements and machine tool electronics which are now entirely imported	These were finalized in 2007 by DHI with inputs from CII and IL&FS as consultants  This is essential to reduce import dependence and also cost of these inputs to machine tool builders
<b><u>Medium term measures to enhance machine tool capabilities and enhance manufacturing competitiveness</u></b> <b><u>To be completed in 1 - 3 years (11<sup>th</sup> Plan period)</u></b>			
16	Adopt development strategy based on development contracts	Large government buyers (strategic, railways, power etc.) may be asked to give development contracts to domestic machine tool companies to meet their special requirements	Practice adopted by all developed countries to develop advanced technology.
17	Adopt development strategy based on development contracts	Large government buyers (strategic, railways, power etc.) may give preference to domestic machine tools on say 30% of their tenders	Coupled with the measure above it will lay a solid framework for advanced machine tool technology development in the country

18	Strengthen R&D and technology development	Government to provide strong support to machine tool technology development: Strengthen CMTI and make it autonomous Establish at least 2/3 more centres in west and north India to support technology development, modernization and product development in the machine tool industries in these regions	This is the approach by China, which has established several R&D centres in machine tools to develop modern, advanced machine tools and manufacturing technology.
19	Under-performance of PSU units: Realise PSU capacities through restructuring Attract investment	Restructure and modernize HMT and HMTP (Ranchi) through part privatization (50% or more) to attract domestic and foreign investment as a means to realize their potential to grow into large machine tool companies. Make companies totally board managed.	These companies represent a potential turnover of around Rs.1000 cr. This can have a salutary impact on the entire machine tool industry in India.
20	Technology gaps: Acquire technology companies Attract investment	Government to facilitate selective acquisition of foreign machine tool companies with technology and market strengths as a strategic measure to support Indian machine tool and manufacturing technology security	Adopted systematically by China in recent years, resulting in Chinese ownership of several top machine tool companies in Europe.
21	Manpower and skill shortage: Creating a manpower development Centre of Excellence	Establish a National Centre for Manufacturing Excellence and Innovation to train and develop technical and managerial professionals at all levels for industry, both machine tools and user industries in manufacturing. (Develop NMCC-CII VLFM initiative)	Manufacturing needs a large pool of trained manpower in the latest technologies and managerial skills. This centre, with industry orientation will focus on developing this manpower pool.

## Roadmap for the Indian Machine Tool Industry 2010-2020



## Annexure 5: Tender Terms: DGOF

Terms of Tender Purchase or Supply Order, DGOF

Ref: D.G.O.F/MM-1 and Annexures to MATERIAL MANAGEMENT AND PROCUREMENT MANUAL For Ordnance Factories. OFB, Nov.2005; Tender Enquiry No.4181 dt 01/06/2009 from SAF, Kanpur as reference

	Terms of tender purchase or supply order	For foreign suppliers	For indigenous suppliers	Disadvantage to Indian suppliers	What is requested from DGOF
1	EMD/Bid gaurantee	As stipulated in the tender terms	Same		
2	Bid currency	USD/other FOB Sea Freight & Insurance PLUS Port + Clearance charges Rs Customs duty Rs Inland transport to site Rs  Installation & Commissioning Rs	FOR destination    Instln & Comm. Rs	Indian supplies often have substantial import content. Cost of this can go high due to currency fluctuation. Indian supplier not safeguarded.	Introduction of an Exchange Rate (ER) Variation Clause for Indian bidders: The bid should declare value of imported items and currency. Any variation in exchange rate up or down, beyond say 2% should be adjusted in price.

3	Bid evaluation	Foreign offers converted to Rs at the ER as on date of evaluation, which is commercial bid opening date	Fixed Rupee price as given in the bid.	Even if foreign supplier is L1 during evaluation, possible ER variation may result in higher Rupee price at time of actual payment (LC) and correspondingly higher customs duty. L1 no longer L1! <u>Price of Indian machine could actually be lower</u>	Justifies the introduction of an ER Variation clause for Indian suppliers, as requested above. <u>Alternative:</u> Ask for price bids from all tenderers, <i>just before announcing technically accepted tenders</i>
4	LD-Delivery delay	0.5% of delayed supplies/week max 5%	Same		
5	Performance Guarantee Bond	5% of contract value at time of letter of acceptance of offer valid till commissioning	Same		
6	Payment terms	90% against irrevocable LC against inspection certificate + shipping documents + PBG for 10% valid till warranty period 10% after commissioning and acceptance, Note: LC will be opened 3 months before due date of shipment, unless supplier wants it earlier in which case it will be opened and extended at supplier's cost.	90% on dispatch and receipt at site in good condition + PBG for 10% valid till warranty period  10% after final commissioning	Foreign suppliers with LC can raise funds at very low interest.  Without LC, Indian bidders have difficulty raising finance for the execution of the order; even with LC, bank finance is very expensive; this itself puts Indian suppliers at price disadvantage (On a 12 month project, around 8-10%)	Either A or B: (A) LC for 100%, 90% against delivery + 10% on commissioning (This will not reduce the cost of funds, though). (B) 40% advance with order ( <i>no interest</i> ); 50% on dispatch + PBG; 10% after final commissioning (This will somewhat restore parity with foreign suppliers)

## Annexure 6: Tender Terms: COFMOW

### Terms of Tender Purchase or Supply Order, COFMOW

Ref: COFMOW Bid Documents Part – I Sections I, II and III 2008

	Terms of tender purchase or supply order, Para	For foreign suppliers	For indigenous suppliers	Disadvantage to Indian suppliers	What is requested
1	EMD/Bid guarantee 0600	As stipulated in the tender terms	Same		
2	Bid currency 1005, 1006	USD/other FOB + Indian supplies Rs Agency commission Freight & Ins Port + Clearance charges Rs Customs duty Rs Inland transport to site Installation & Commissioning Rs (Non turn-key)	CIP Destination      Inst & Comm (Non turn-key)	Indian supplies often have substantial import content. Cost of this can go high due to currency fluctuation. Indian supplier not safeguarded.	Introduction of an Exchange Rate (ER) Variation Clause for Indian bidders: The bid should declare value of imported items and currency. Any variation in exchange rate up or down, beyond say 2% should be adjusted in price.
3	Evaluation 1202	Possibility of earlier payment , at 12% interest, if variation in payment terms requested and accepted by purchaser	Not available		May be made available to Indian bidders also.
4	Evaluation 1202	FE offers converted to Rs at the BC selling price as on date of bid for inter-se position of offers; duties as on bid date	Fixed Rupee price as in the bid.	Even if foreign supplier is L1 during evaluation, possible ER variation may actually result in higher price at time of actual payment (LC) and correspondingly higher customs duty. L1 no	Justifies the introduction of an ER Variation clause for Indian suppliers, as requested above. Also, FE offers should be converted as on date of bid opening and not bid date!  <u>Alternative:</u> Ask for price bids from all tenderers <i>after</i>



				<u>longer L1! Price of Indian machine could actually be lower</u>	technical evaluation but <i>before announcing technically accepted tenders</i>
5	Delivery delay GTC 1002	2% of delayed supplies/month max 10%	Same		
6	Commissioning delay GTC 0400	2% of total contract value/month max 10%	Same		
7	Performance Guarantee Bond GTC 0700	10% of contract value at time of letter of acceptance of offer valid till commissioning	Same		
8	Payment terms GTC 1800/1802	<p>80% against irrevocable LC against inspection certificate + shipping documents 20% after commissioning and acceptance, against Performance BG for 10% valid till warranty period.</p> <p>For SPM 80% + 10% on acceptance + 10% after warranty period</p>	<p>80% on receipt at site in good condition 20% after commissioning and acceptance, against PBG for 10% valid till warranty period</p> <p>Same</p>	<p>Foreign suppliers with LC can raise funds at very low interest. Without LC, Indian bidders have difficulty raising finance for the execution of the order; even with LC, bank finance is very expensive; this itself puts Indian suppliers at cost disadvantage (On a 12 month project, around 8-10%)</p>	<p>Either A or B:</p> <p>(A) LC for 90% against delivery + 10% on commissioning (This will not reduce the cost of funds, though).</p> <p>(B) 40% advance with order (no interest); 50% on dispatch; 10% on commissioning (This will somewhat restore parity with foreign suppliers)</p>

## Annexure 7: Development Contract as a route to Technology Development

The development of machine tools in India has largely been based on individual companies' initiatives. These have been in response to market needs and technology demands from user industries. HMT initially and other companies subsequently have developed and manufactured CNC machines, special purpose machines and a host of other products through their own R&D. In some cases they have drawn on the financial support from NCST, DSIR and other agencies set up to fund industrial R&D.

These efforts have paid dividends in so far as standard products are concerned, but the development of specialized machines required by users like auto components, DGOF, BHEL, Railways, DAE etc. has not kept pace with their requirements basically because of the small number and infrequent demand. As a result, these industries have imported their requirements from foreign companies which have the technology and the capacity to produce these machines. Examples: large VTLs, floor boring machines, multi-axes machines, high precision grinding, gear cutting, and similar technologies. As already pointed out, these are technology gap areas which need to be filled.

The R&D required for these technologies is expensive and also time-consuming. Risks are also high. Still, a way has to be found to develop these technologies in India as a strategy to secure the latest manufacturing technology and machine tool capability for the country.

One way to resolve this is to adopt the "Development Contract" route used by many countries. This route has been traditionally used abroad for the development of new, high technology machines. In the US, companies like GM, GE, Boeing, Lockheed, DoD, DoE etc. routinely award development contracts to manufacturers for the development of advanced machines and manufacturing technologies. In many cases, government agencies also directly fund companies to develop new machine tools. For example, the NSF has funded the development of the Hexapod Machine Tool to Ingersoll; the NIST has an ongoing project with the University of Michigan for Reconfigurable Machine Tools.

In the 60s and 70s, the Japanese Govt. in consortium with certain Japanese Heavy Industries like Steel, Shipping etc. which were well developed and profit making, actively promoted industry groups – such as Watch Industry, Electronics and Entertainment Industry, Automobile Industry etc., not just for domestic, but also for International markets. Concessions were given to these industries to invest in product R&D, product promotion for International (US & European) markets. Established industries such as Steel, Shipping etc. were asked to support the fledgling industries mentioned above in whatever manner possible to stabilize them and allow them to grow. Each such industry group that benefited from this initiative supported the next developing one. Thus they promoted their entrepreneurs to become global players.

The DHI may approach the issue on similar lines in respect of the machine tool industry wherein heavy industries such as BHEL, HEC, all the Steel Plants, Larsen & Toubro and many private sector industries, along with the Govt., may promote the machine tool industry by helping them invest substantially in R&D and develop products to suit their own requirements through **risk sharing contracts**. This way, the machine tool industry could rapidly come of age and be a lead player within the country as well as develop a high export potential.

Development contracts are finalized on the following basis:

- The requirements are conveyed to industry
- Companies are invited to bid for these contracts
- Bids are evaluated on the basis of the companies' capabilities and other factors
- Contract values are negotiated based on content and risk
- Development contract is awarded to the best-fit company

The risks of development are shared by the user and the machine tool company, and the government in some cases. Successful development phase is followed by a commercial production. If the development fails there is no penalty on the company, provided failure is due to valid technical reasons.

It is strongly recommended that this concept be adopted by large users in India such as automobiles, auto-components, government buyers to develop their future requirement of machines by Indian companies on a risk-sharing basis. Examples would be large machine tools for the power sector, BHEL, special machines for Railways, DGOF, DRDO, HAL, ISRO, DAE etc. At least 30% of their future requirements could be awarded as development contracts to Indian machine tool companies after a suitable evaluation of the companies.

This practice is not entirely new to Indian industry. ISRO, BARC, ADA have adopted this route successfully to develop their specialized requirements (especially where there is no recourse to imports due to denials). What needs to be done is to formalize and extend this to more products and technologies in machine tools to encourage indigenous development. This is a strategic need as much as a commercial need.

## Annexure 8 : Extracts from IAEA guide lines of “dual-use” equipment



Information Circular

**INFCIRC/254/Rev.7/Part 2<sup>a</sup>**

Date: 20 March 2006

**General Distribution**

Original: English

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### Communications Received from Certain Member States Regarding Guidelines for Transfers of Nuclear-related Dual-use Equipment, Materials, Software and Related Technology

## **GUIDELINES FOR TRANSFERS OF NUCLEAR-RELATED DUAL-USE EQUIPMENT, MATERIALS, SOFTWARE, AND RELATED TECHNOLOGY**

### **OBJECTIVE**

1. With the objective of averting the proliferation of nuclear weapons and preventing acts of nuclear terrorism, suppliers have had under consideration procedures in relation to the transfer of certain equipment, materials, software, and related technology that could make a major contribution to a “nuclear explosive activity,” an “unsafeguarded nuclear fuel-cycle activity” or acts of nuclear terrorism. In this connection, suppliers have agreed on the following principles, common definitions, and an export control list of equipment, materials, software, and related technology. The Guidelines are not designed to impede international co-operation as long as such co-operation will not contribute to a nuclear explosive activity, an unsafeguarded nuclear fuel-cycle activity or acts of nuclear terrorism. Suppliers intend to implement the Guidelines in accordance with national legislation and relevant international commitments.

### **BASIC PRINCIPLE**

2. Suppliers should not authorize transfers of equipment, materials, software, or related technology identified in the Annex:
  - for use in a non-nuclear-weapon state in a nuclear explosive activity or an unsafeguarded nuclear fuel-cycle activity, or
  - in general, when there is an unacceptable risk of diversion to such an activity, or when the transfers are contrary to the objective of averting the proliferation of nuclear weapons, or
  - when there is an unacceptable risk of diversion to acts of nuclear terrorism.

### **CONDITIONS FOR TRANSFERS**

6. In the process of determining that the transfer will not pose any unacceptable risk of diversion, in accordance with the Basic Principle and to meet the objectives of the Guidelines, the supplier should obtain, before authorizing the transfer and in a manner consistent with its national law and practices, the following:
  - (a) a statement from the end-user specifying the uses and end-use locations of the proposed transfers; and
  - (b) an assurance explicitly stating that the proposed transfer or any replica thereof will not be used in any nuclear explosive activity or unsafeguarded nuclear fuel-cycle activity.

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1.B. TEST AND PRODUCTION EQUIPMENT

1.B.1. Flow-forming machines, spin-forming machines capable of flow-forming functions, and mandrels, as follows:

a. Machines having both of the following characteristics:

1. Three or more rollers (active or guiding); and
2. Which, according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control;

1-3

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- b. Rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 and 400 mm.

Note: Item 1.B.1.a. includes machines which have only a single roller designed to deform metal plus two auxiliary rollers which support the mandrel, but do not participate directly in the deformation process.

- 1.B.2. Machine tools, as follows, and any combination thereof, for removing or cutting metals, ceramics, or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

N.B.: For "numerical control" units controlled by their associated "software", see Item 1.D.3.

- a. Machine tools for turning, that have "positioning accuracies" with all compensations available better (less) than 6  $\mu\text{m}$  according to ISO 230/2 (1988) along any linear axis (overall positioning) for machines capable of machining diameters greater than 35 mm;

Note: Item 1.B.2.a. does not control bar machines (Swissturn), limited to machining only bar feed thru, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm.

- b. Machine tools for milling, having any of the following characteristics:

1. "Positioning accuracies" with all compensations available better (less) than 6  $\mu\text{m}$  according to ISO 230/2 (1988) along any linear axis (overall positioning);
2. Two or more contouring rotary axes; or
3. Five or more axes, which can be coordinated simultaneously for "contouring control".

Note: Item 1.B.2.b. does not control milling machines having both of the following characteristics:

1. X-axis travel greater than 2 m; and
2. Overall "positioning accuracy" on the x-axis worse (more) than 30  $\mu\text{m}$  according to ISO 230/2 (1988).

- c. Machine tools for grinding, having any of the following characteristics:

1. "Positioning accuracies" with all compensations available better (less) than 4  $\mu\text{m}$  according to ISO 230/2 (1988) along any linear axis (overall positioning);
2. Two or more contouring rotary axes; or
3. Five or more axes, which can be coordinated simultaneously for "contouring control".

Note: Item 1.B.2.c. does not control grinding machines as follows:

1. Cylindrical external, internal, and external-internal grinding machines having all the following characteristics:

- a. Limited to a maximum workpiece capacity of 150 mm outside diameter or length; and
  - b. Axes limited to x, z and c.
2. Jig grinders that do not have a z-axis or a w-axis with an overall positioning accuracy less (better) than 4 microns. Positioning accuracy is according to ISO 230/2 (1988).
- d. Non-wire type Electrical Discharge Machines (EDM) that have two or more contouring rotary axes and that can be coordinated simultaneously for "contouring control".

Notes: 1. Stated "positioning accuracy" levels derived under the following procedures from measurements made according to ISO 230/2 (1988) or national equivalents may be used for each machine tool model if provided to, and accepted by, national authorities instead of individual machine tests.

Stated "positioning accuracy" are to be derived as follows:

- a. Select five machines of a model to be evaluated;
  - b. Measure the linear axis accuracies according to ISO 230/2 (1988);
  - c. Determine the accuracy values (A) for each axis of each machine. The method of calculating the accuracy value is described in the ISO 230/2 (1988) standard;
  - d. Determine the average accuracy value of each axis. This average value becomes the stated "positioning accuracy" of each axis for the model ( $\bar{A}_x, \bar{A}_y, \dots$ );
  - e. Since Item 1.B.2. refers to each linear axis, there will be as many stated "positioning accuracy" values as there are linear axes;
  - f. If any axis of a machine tool not controlled by Items 1.B.2.a., 1.B.2.b., or 1.B.2.c. has a stated "positioning accuracy" of 6  $\mu\text{m}$  or better (less) for grinding machines, and 8  $\mu\text{m}$  or better (less) for milling and turning machines, both according to ISO 230/2 (1988), then the builder should be required to reaffirm the accuracy level once every eighteen months.
2. Item 1.B.2. does not control special purpose machine tools limited to the manufacture of any of the following parts:
- a. Gears
  - b. Crankshafts or camshafts
  - c. Tools or cutters
  - d. Extruder worms

Technical Notes: 1. Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machines - Axis and Motion Nomenclature".

2. Not counted in the total number of contouring axes are secondary parallel contouring axes (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the centerline of which is parallel to the primary rotary axis).
3. Rotary axes do not necessarily have to rotate over 360 degrees. A rotary axis can be driven by a linear device, e.g., a screw or a rack-and-pinion.
4. For the purposes of 1.B.2. the number of axes which can be coordinated simultaneously for "contouring control" is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative motions within the machine are performed, such as:
  - a. Wheel-dressing systems in grinding machines;
  - b. Parallel rotary axes designed for mounting of separate workpieces;
  - c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.
5. A machine tool having at least 2 of the 3 turning, milling or grinding capabilities (e.g., a turning machine with milling capability) must be evaluated against each applicable entry, 1.B.2.a., 1.B.2.b. and 1.B.2.c.
6. Items 1.B.2.b.3 and 1.B.2.c.3 include machines based on a parallel linear kinematic design (e.g., hexapods) that have 5 or more axes none of which are rotary axes.

1.B.3. Dimensional inspection machines, instruments, or systems, as follows:

- a. Computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:
  1. Two or more axes; and
  2. A one-dimensional length "measurement uncertainty" equal to or better (less) than  $(1.25 + L/1000) \mu\text{m}$  tested with a probe of an "accuracy" of better (less) than  $0.2 \mu\text{m}$  (L is the measured length in millimeters) (Ref: VDI/VDE 2617 parts 1 and 2);
- b. Linear displacement measuring instruments, as follows:
  1. Non-contact type measuring systems with a "resolution" equal to or better (less) than  $0.2 \mu\text{m}$  within a measuring range up to 0.2 mm;
  2. Linear variable differential transformer (LVDT) systems having both of the following characteristics:
    - a. "Linearity" equal to or better (less) than 0.1% within a measuring range up to 5 mm; and
    - b. Drift equal to or better (less) than 0.1% per day at a standard ambient test room temperature  $\pm 1 \text{ K}$ ;

3. Measuring systems having both of the following characteristics:

- a. Contain a laser; and
- b. Maintain for at least 12 hours, over a temperature range of  $\pm 1$  K around a standard temperature and a standard pressure:
  1. A "resolution" over their full scale of  $0.1 \mu\text{m}$  or better; and
  2. With a "measurement uncertainty" equal to or better (less) than  $(0.2 + L/2000) \mu\text{m}$  (L is the measured length in millimeters);

Note: Item 1.B.3.b.3. does not control measuring interferometer systems, without closed or open loop feedback, containing a laser to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment.

Technical Note: In Item 1.B.3.b. 'linear displacement' means the change of distance between the measuring probe and the measured object.

- c. Angular displacement measuring instruments having an "angular position deviation" equal to or better (less) than  $0.00025^\circ$ ;

Note: Item 1.B.3.c. does not control optical instruments, such as autocollimators, using collimated light (e.g., laser light) to detect angular displacement of a mirror.

- d. Systems for simultaneous linear-angular inspection of hemishells, having both of the following characteristics:

1. "Measurement uncertainty" along any linear axis equal to or better (less) than  $3.5 \mu\text{m}$  per 5 mm; and
2. "Angular position deviation" equal to or less than  $0.02^\circ$ .

- Notes:
1. Item 1.B.3. includes machine tools that can be used as measuring machines if they meet or exceed the criteria specified for the measuring machine function.
  2. Machines described in Item 1.B.3. are controlled if they exceed the threshold specified anywhere within their operating range.

- Technical Notes:
1. The probe used in determining the measurement uncertainty of a dimensional inspection system shall be as described in VDI/VDE 2617 parts 2, 3 and 4.
  2. All parameters of measurement values in this item represent plus/minus, i.e., not total band.
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## Annexure 9: World Machine Tool Statistics



### World Machine Tool Output & Consumption Survey

#### Production

Country	2009 (est.)			2008 (rev.) \$-Millions	Change	
	\$-Millions	% Cut	% Form		in local currency	in U.S. dollars
1.China, Peoples Rep.	15,000.0	73%	27%	13,960.0	\$	7%
2.Germany	10,428.8	75%	25%	15,680.2	-30%	-33%
3.Japan	7,095.1	83%	17%	15,566.5	-59%	-54%
4.Italy	5,239.4	49%	51%	7,831.3	-30%	-33%
5.Korea, Rep. of	2,665.0	64%	36%	4,372.0	\$	-39%
6.Taiwan	2,419.4	80%	20%	4,807.1	-47%	-50%
7.United States	2,324.4	73%	27%	3,938.5	\$	-41%
8.Switzerland	2,118.4	81%	19%	4,013.4	-47%	-47%
9.Spain	1,060.3	66%	34%	1,544.8	-28%	-31%
10.Brazil	c1,030.9	81%	19%	1,288.7	\$	-20%
11.Austria	857.3	50%	50%	1,227.3	-26%	-30%
12.France	764.8	73%	27%	1,276.0	-37%	-40%
13.Czech Republic	589.5	87%	13%	963.6	-39%	-39%
14.United Kingdom	499.1	75%	25%	760.3	-23%	-34%
15.Turkey	454.7	29%	71%	614.6	\$	-26%
16.Canada	c434.0	62%	38%	645.9	-33%	-33%
17.Belgium	369.9	10%	90%	499.0	-22%	-26%
18.Netherlands	340.7	20%	80%	512.1	-30%	-33%
19.India	268.2	80%	20%	403.6	-26%	-34%
20.Russia	230.1	59%	41%	420.5	-30%	-45%
21.Finland	180.8	10%	90%	300.0	-37%	-40%
22.Sweden	147.4	35%	65%	248.8	-38%	-41%
23.Australia	135.0	81%	19%	133.0	\$	2%
24.Mexico	c132.5	52%	48%	c164.6	\$	-20%
25.Denmark	112.6	40%	60%	168.3	-30%	-33%
26.Portugal	80.6	5%	95%	81.9	4%	-2%
27.Romania	uc36.4	71%	29%	54.8	-30%	-33%
28.Argentina	29.3	44%	56%	36.7	\$	-20%
<b>Total</b>	<b>55,044.6</b>			<b>81,513.5</b>		<b>-32%</b>

u = unrevised from previous year but converted at current rates.

% = ratio of cutting/forming production estimated from previous reports in some cases

c = circa; rough estimate from fragmentary reports.

\$ = reported in U.S. dollars.

Source: Gardner Publications, Inc.

## Per-Capita Consumption

<u>Country</u>	2009		
	<u>Consumption</u>	<u>Population</u>	<u>Consumption</u>
	<u>\$-Millions</u>	<u>000s</u>	<u>\$/Capita</u>
1.Switzerland	865.8	7,604	\$113.86
2.Austria	622.4	8,215	\$75.76
3.Germany	5,450.8	82,329	\$66.21
4.Korea, Rep. of	2,586.0	48,508	\$53.31
5.Italy	2,740.7	58,126	\$47.15
6.Belgium	464.4	10,414	\$44.60
7.Taiwan	846.8	22,974	\$36.86
8.Sweden	311.5	9,059	\$34.38
9.Czech Republic	338.1	10,211	\$33.11
10.Finland	153.0	5,250	\$29.13
11.Japan	3,319.0	127,078	\$26.12
12.Denmark	136.3	5,500	\$24.78
13.Canada	720.1	33,487	\$21.50
14.Netherlands	347.6	16,715	\$20.80
15.France	1,133.3	64,420	\$17.59
16.China, Peoples Rep.	19,400.0	1,323,591	\$14.66
17.Spain	559.5	40,525	\$13.81
18.Portugal	140.4	10,707	\$13.12
19.Australia	234.0	21,262	\$11.01
20.United States	3,369.5	307,212	\$10.97
21.Brazil	2,160.9	198,739	\$10.87
22.Romania	239.2	22,215	\$10.77
23.Mexico	1,005.7	111,211	\$9.04
24.Turkey	625.7	76,805	\$8.15
25.United Kingdom	397.7	61,113	\$6.51
26.Russia	692.0	140,041	\$4.94
27.Argentina	149.6	40,913	\$3.66
28.India	1,156.6	1,156,897	\$1.00

Apparent Consumption = local Production, less Exports, plus Imports

Source: Gardner Publications, Inc.

## Imports

<u>Country</u>	<u>\$-Millions</u>		<u>Change</u>		<u>Imports *</u>
	<u>2009 (est.)</u>	<u>2008 (rev.)</u>	<u>in local</u>	<u>in U.S.</u>	<u>as % of '09</u>
			<u>currency</u>	<u>dollars</u>	<u>consumption</u>
1.China, Peoples Rep.	5,800.0	7,587.0	\$	-24%	30%
2.United States	2,259.6	4,874.0	\$	-54%	67%
3.Germany	2,224.8	4,337.1		-46%	41%
4.Brazil	c1,246.7	1,454.7	\$	-14%	58%
5.Korea, Rep. of	1,133.0	1,334.0	\$	-15%	44%
6.France	924.7	1,417.9		-31%	82%
7.Mexico	906.3	1,422.9	\$	-36%	90%
8.India	900.7	1,573.2		-36%	78%
9.Italy	817.6	2,151.0		-60%	30%
10.Belgium	721.7	1,132.6		-33%	155%
11.Switzerland	571.0	887.3		-35%	66%
12.Turkey	545.1	981.7	\$	-44%	87%
13.Russia	541.5	989.5		-30%	78%
14.Canada	532.9	890.1	\$	-40%	74%
15.United Kingdom	467.9	953.2		-42%	118%
16.Austria	447.1	702.2		-33%	72%
17.Japan	442.8	743.2		-46%	13%
18.Taiwan	362.9	1,531.3		-75%	43%
19.Sweden	308.7	519.5		-37%	99%
20.Spain	299.1	692.6		-55%	53%
21.Czech Republic	264.6	777.6		-66%	78%
22.Romania	uc253.8	381.6		-30%	106%
23.Netherlands	250.3	439.0		-40%	72%
24.Australia	199.0	360.0	\$	-45%	85%
25.Argentina	139.8	250.7	\$	-44%	93%
26.Portugal	119.6	139.0		-9%	85%
27.Finland	111.2	317.5		-63%	73%
28.Denmark	100.1	330.7		-68%	73%

\* = includes machines imported for re-export

u = unrevised from previous year but converted at current rates.

c = circa; rough estimate from fragmentary reports.

\$ = reported in U.S. dollars.

Source: Gardner Publications, Inc.

## Exports

Country	\$-millions		Change		Exports* as % of '09 production
	2009 (est.)	2008 (rev.)	in local currency	in U.S. dollars	
1.Germany	7,202.8	10,261.8	-26%	-30%	69%
2.Japan	4,219.0	8,516.8	-55%	-50%	59%
3.Italy	3,316.4	4,691.2	-26%	-29%	63%
4.Taiwan	1,935.5	3,700.6	-45%	-48%	80%
5.Switzerland	1,823.7	3,333.9	-45%	-45%	86%
6.China, Peoples Rep.	1,400.0	2,106.0	\$	-34%	9%
7.United States	1,214.5	1,892.8	\$	-36%	52%
8.Korea, Rep. of	1,212.0	1,910.0	\$	-37%	45%
9.Spain	799.8	1,077.0	-22%	-26%	75%
10.Austria	681.9	1,025.2	-30%	-33%	80%
11.Belgium	627.1	1,100.4	-40%	-43%	170%
12.United Kingdom	569.3	931.0	-28%	-39%	114%
13.France	556.2	822.3	-29%	-32%	73%
14.Czech Republic	516.0	859.7	-40%	-40%	88%
15.Turkey	374.0	486.7	\$	-23%	82%
16.Canada	246.8	379.9	\$	-35%	57%
17.Netherlands	243.3	425.8	-40%	-43%	71%
18.Sweden	144.6	242.9	-37%	-40%	98%
19.Finland	139.1	231.2	-37%	-40%	77%
20.Brazil	c116.7	196.2	\$	-41%	11%
21.Australia	100.0	93.0	\$	8%	74%
22.Russia	79.6	145.6	\$	-45%	35%
23.Denmark	76.5	155.1	-48%	-51%	68%
24.Portugal	59.8	48.3	30%	24%	74%
25.Romania	cu51.1	76.8	-30%	-33%	140%
26.Mexico	33.1	41.2	\$	-20%	25%
27.Argentina	19.5	14.6	\$	34%	67%
28.India	12.3	22.2	-38%	-45%	5%

\* = includes re-exported machines

u = unrevised from previous year but converted at current rates.

c = circa; rough estimate from fragmentary reports.

\$ = reported in U.S. dollars.

Source: Gardner Publications, Inc.