DETAILED PROJECT REPORT
ON
REPLACEMENT OF CONVENTIONAL M/C WITH CNC M/C
(BANGALORE MACHINE TOOL CLUSTER)











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REPLACEMENT OF CONVENTIONAL MACHINE
TO
CNC MACHINE

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

Detailed Project Report on Replacement of Conventional Machine to CNC Machine

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Petroleum Conservation Research Association

Bangalore

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List of Abbreviations

kWh	kilo Watt Hour
GDP	Gross Domestic Product
GoI	Government Of India
MSME	Micro Small and Medium Enterprises
GHG	Green House Gas
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
O&M	Operational & Maintenance
NPV	Net Present Values
ROI	Return on Investment
IRR	Internal Rate Of Return
DSCR	Debt Service Coverage Ratio
PBT	Profit Before Tax
PAT	Profit After Tax
CNC	Computer Numerical Controlled
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Bureau of Energy Efficiency (BEE) appointed Petroleum Conservation Research Association as the executing agency for Machine Tools of Bangalore under BEE's SME programme. Under this project, the executing agency carried out studies in the Machine Tools of Bangalore. Out of a total of 100 machine tools units, study was conducted in 30 units. Preliminary audits were undertaken in all the 30 units whereas detailed energy audits were conducted in 10 of these units.

Bangalore has evolved as one of the most important production centers in the Machine tool sector despite there being nothing favorable for proliferation of a cluster. The place lacks all possible resources, from raw materials to fuels and to skilled man power newer technologies as well which is the most important for processing of Machine tools. Today there are 100 units in Bangalore alone and the production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum.

Energy forms a major chunk of the processing cost with over 30% weight age in the cost basket. As per the preliminary and detailed energy audit findings, there exists potential of saving over 30% electricity and 50% fuel in the applications in power process industries with over all general payback period of less than six year. The payback period in these industries is higher due to their working schedule and lower utilization of facilities.

Based on the energy audits, the executing agency submitted their report to BEE in form of a cluster manual with recommendations for energy conservation & savings potentials in the Machine Tools sector. The one of the recommendation made in the cluster manual is listed below:

This bankable DPR also found eligible for subsidy scheme of MoMSME for "Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises" under "National Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S. No	*Particular*	*Unit*	*Value*
1	Project cost	` (in lakh)	38.80
2	Electricity saving	kWh	44523
3	Monetary benefit	` (in lakh)/ Year	14.31
4	Simple payback period	Year	2.71
5	NPV	` (in lakh)	25.66
6	IRR	%age	23.43

S. No	Particular	Unit	Value
7	ROI	%age	21.11
8	DSCR	ratio	1.69
9	CO2 reduction	Tonne/annum	33.4
10	Procurement and implementation schedule	week	8

The projected profitability and financial indicators shows that the project will be able to earn profit from inception and project is financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Gujarat Dairy Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion

1 INTRODUCTION

1.1 Brief about the SME cluster

About SME cluster

The Machine Tools Cluster of Bangalore is located in the Bangalore district. Bangalore, also known as Bengaluru is the capital of the Indian state of Karnataka, located on the Deccan Plateau in the south-eastern part of Karnataka. Bangalore was inducted in the list of Global cities and ranked as a "Beta World City" alongside Geneva, Copenhagen, Boston, Cairo, Riyadh, Berlin, to name a few, in the studies performed by the Globalization and World Cities Study Group and Network in 2008. These machine units have been classified into following clusters within the district:

- Abbegere
- Bommasandra
- Peenya

Bangalore is the “HUB” for machine tools in India. The cluster accounts for 60% of the value of production of machine tools in the country. Bangalore is predominantly a metal cutting cluster. The structure of machine tool industry in Bangalore has at its apex 6 large machine tool manufacturers, about 100 small and medium machine tool manufacturers, their suppliers and vendors in large numbers.

Product Manufactured

In SME cluster of Machine Tools at Bangalore, there are varieties of products manufactured that include spindles, centre grinding machines, ID grinding machines, Self centering Steady Rests, Bar feeding attachments, Rotary tables, Index tables, Special purpose machines, Co-ordinate Measuring machines, aerospace fixtures, CNC Machine enclosures, Sound proofs, armature rewinding machines etc. There are supporting industries like heat treatment are also located in the cluster. These products/ machines are usually utilized in automobile industry, aerospace industry, CNC Machine industry across the globe. These are products custom made to suit the requirements of ISRO, HAL, BEML, MICO, BHEL, Kirloskar Electric, Bayforge Ltd etc.

Production Process

Typically, process for machine tool units in Bangalore is not the same for all industries involving various activities, as the end products of the industry are different for each industrial unit. Therefore, there is some variation in the flow of activities depending on the customized requirement of the products. However, these activities could be grouped together as shown below, though not in the same order as mentioned.

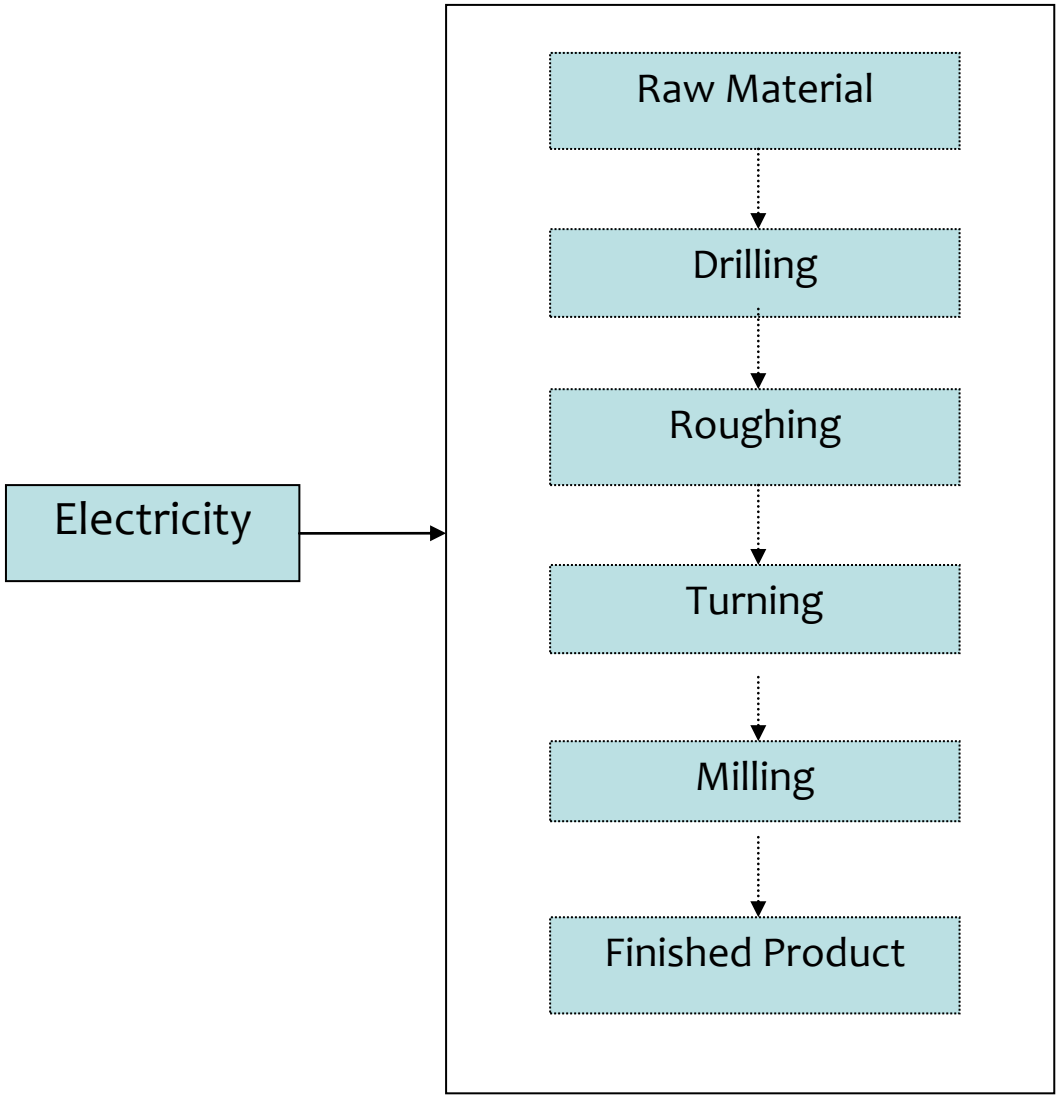
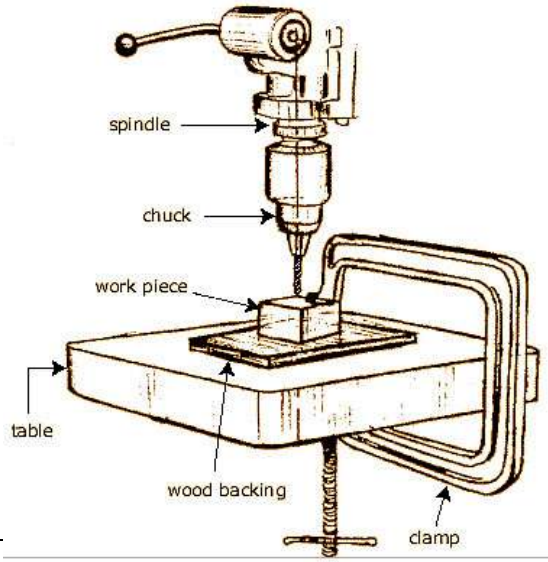


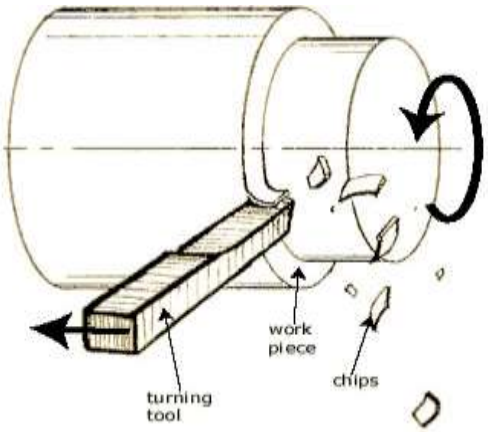
Figure 1.1 Process flow chart of typical Machine Tools Unit

Drilling Process



Drilling is the most common machining process whereby the operation involves making round holes in metallic and nonmetallic materials. Approximately 75% of all metal- cutting process is of the drilling operation. Drills usually have a high length to diameter ratio that is capable of producing deep hole, however due to its flexibility, necessary precaution need to be

taken to maintain accuracy and prevent drill from breaking.



Drilled holes can be either through holes or blind holes. A through hole is made when a drill exits the opposite side of the work; in blind hole the drill does not exit the workpiece.

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

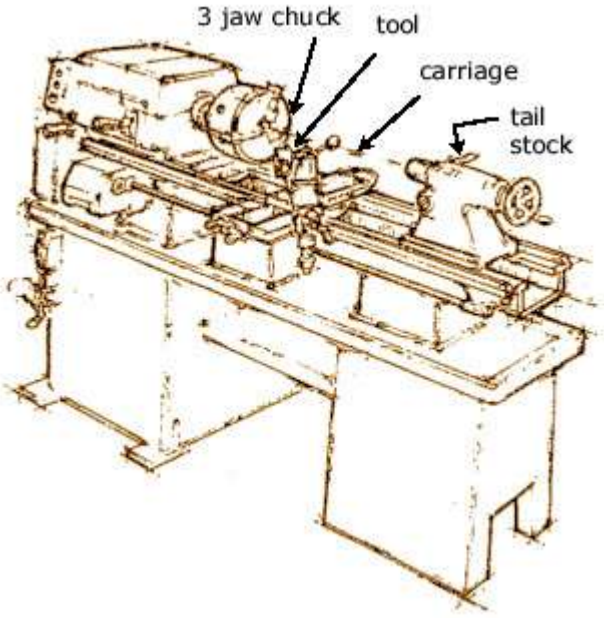
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

For fluted drill bits, any chips are removed via the flutes. Chips may be long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long gummy chips reducing machinability.

When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

Turning Process

Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or lathe, work piece, fixture, and cutting tool. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and allowed to rotate at high speeds. The cutter is typically a single-point cutting tool that is also secured in the machine, although some operations make use of



multi-point tools. The cutting tool feeds into the rotating work piece and cuts away material in the form of small chips to create the desired shape. Turning is used to produce rotational, typically axi-symmetric, parts that have many features, such as holes, grooves, threads, tapers, various diameter steps, and even contoured surfaces. Parts that are fabricated completely through turning often include components that are used in limited quantities, perhaps for prototypes, such as custom designed shafts and fasteners. Turning is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Due to the high tolerances and surface finishes that turning can offer, it is ideal for adding precision rotational features to a part whose basic shape has already been formed.

Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated lathe which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC. and is commonly used with many other types of machine tool besides the lathe.

When turning, a piece of material (wood, metal, plastic, or stone) is rotated and a cutting tool is traversed along 2 axes of motion to produce precise diameters and depths. Turning can be either on the outside of the cylinder or on the inside (also known as boring) to produce tubular components to various geometries. Although now quite rare, early lathes could even be used to produce complex geometric figures, even the platonic solids; although until the advent of CNC it had become unusual to use one for this purpose for the last three quarters of the twentieth century. It is said that the lathe is the only machine tool that can reproduce itself.

The turning processes are typically carried out on a lathe, considered to be the oldest machine tools, and can be of four different types such as straight turning, taper turning, profiling or external grooving. Those types of turning processes can produce various shapes of materials such as straight, conical, curved, or grooved work piece. In general, turning uses simple single-point cutting tools. Each group of work piece materials has an optimum set of tools angles, which have been developed through the years.

The bits of waste metal from turning operations are known as chips (North America), or swarf (Britain). In some areas they may be known as turnings.

Turning specific operations include:

Hard turning

Hard turning is a turning done on materials with a Rockwell C hardness greater than 45. It is typically performed after the work piece is heat treated.

The process is intended to replace or limit traditional grinding operations. Hard turning, when applied for purely stock removal purposes, competes favourably with rough grinding. However, when it is applied for finishing where form and dimension are critical, grinding is superior. Grinding produces higher dimensional accuracy of roundness and cylindricity. In addition, polished surface finishes of Rz=0.3-0.8z cannot be achieved with hard turning alone. Hard turning is appropriate for parts requiring roundness accuracy of 0.5-12 microns, and/or surface roughness of Rz 0.8–7.0 microns. It is used for gears, injection pump components, hydraulic components, among other applications.

Facing

It is part of the turning process. It involves moving the cutting tool at right angles to the axis of rotation of the rotating workpiece. This can be performed by the operation of the cross-slide, if one is fitted, as distinct from the longitudinal feed (turning). It is frequently the first operation performed in the production of the work piece, and often the last- hence the phrase "ending up".

Parting

This process is used to create deep grooves which will remove a completed or part-complete component from its parent stock.

Grooving

Grooving is like parting, except that grooves are cut to a specific depth by a form tool instead of severing a completed/part-complete component from the stock. Grooving can be performed on internal and external surfaces, as well as on the face of the part (face grooving or trepanning).

Non-specific operations include:

Boring

Machining of internal cylindrical forms (generating) a) by mounting work piece to the spindle via a chuck or faceplate b) by mounting work piece onto the cross slide and placing cutting tool into the chuck. This work is suitable for castings that are to awkward to mount in the face plate. On long bed lathes large work piece can be bolted to a fixture on the bed and a shaft passed between two lugs on the work piece and these lugs can be bored out to size. In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole.

There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Line boring (line boring, line-boring) implies the former. Back boring (back boring,

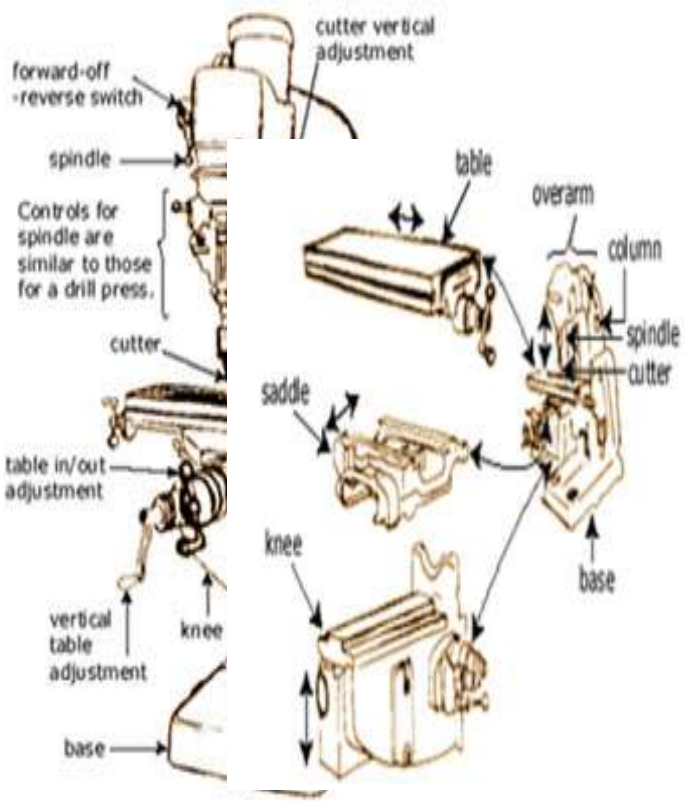
back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

Knurling

Threading both standard and non-standard screw threads can be turned on a lathe using an appropriate cutting tool. (Usually having a 60, or 55° nose angle) Either externally, or within a bore. [Generally referred to as single-point threading. tapping of threaded nuts and holes a) using hand taps and tailstock centre b) using a tapping device with a slipping clutch to reduce risk of breakage of the tap threading operations include a) all types of external and internal thread forms using a single point tool also taper threads, double start threads, multi start threads, worms as used in worm wheel reduction boxes, lead screw with single or multi start threads. b) by the use of threading boxes fitted with 4 form tools, up to 2" diameter threads but it is possible to find larger boxes than this.

Milling Process

Milling is the most common form of machining, a material removal process, which can create a variety of features on a part by cutting away the unwanted material. The milling process requires a milling machine, work piece, fixture, and cutter. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to a platform inside the milling machine. The cutter is a cutting tool with sharp teeth, which is also secured in the milling machine and rotates at high speeds. By feeding the workpiece into the rotating cutter, material is cut away from this work piece in the form of small chips to create the desired shape.



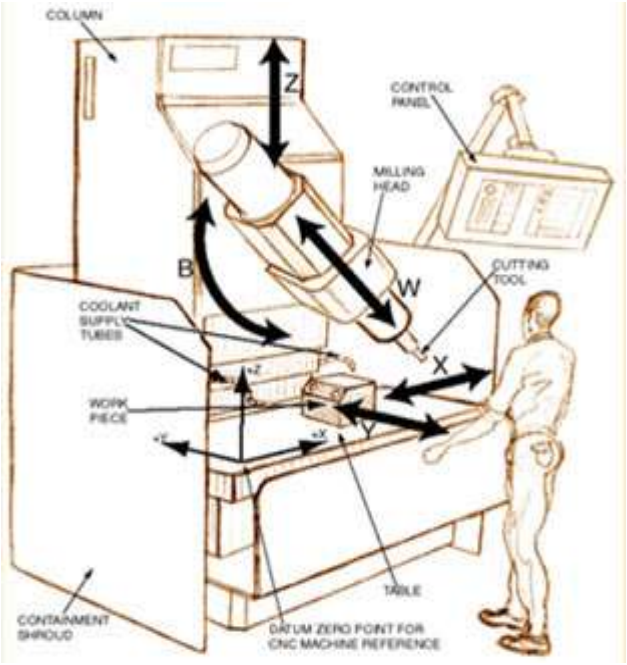
Milling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three-dimensional surface contours. Parts that are fabricated completely through milling often include components that are used in limited quantities, perhaps for prototypes, such as custom designed fasteners or brackets. Another application of milling is the fabrication of tooling for other processes. For example, three-dimensional molds are typically milled. Milling is also commonly used as a secondary process to add or refine features on parts that were manufactured

using a different process. Due to the high tolerances and surface finishes that milling can offer, it is ideal for adding precision features to a part whose basic shape has already been formed.

Milling is as fundamental as drilling among powered metal cutting processes. Milling is versatile for a basic machining process, but because the milling set up has so many degrees of freedom, milling is usually less accurate than turning or grinding unless especially rigid fixturing is implemented. For manual machining, milling is essential to fabricate any object that is not axially symmetric. Below is illustrated the process at the cutting area. A typical column-and-knee type manual mill is shown. Such manual mills are common in job shops that specialize in parts that are low volume and quickly fabricated. Such job shops are often termed 'model shops' because of the prototyping nature of the work.

The parts of the manual mill are separated below. The knee moves up and down the column on guide ways in the column. The table can move in x and y on the knee, and the milling head can move up and down.

CNC Milling: Computer Numerical Control (CNC) Milling is the most common form of CNC. CNC mills can perform the functions of drilling and often turning. CNC Mills are classified according to the number of axes that they possess. Axes are labeled as x and y for horizontal movement, and z for vertical movement, as shown in this view of a manual mill table. A standard manual light-duty mill is typically assumed to have four axes: Table X, Table Y, Table Z and milling head Z.



A five-axis CNC milling machine has an extra axis in the form of a horizontal pivot for the milling head. This allows extra flexibility for machining with the end mill at an angle with respect to the table. A six-axis CNC milling machine would have another horizontal pivot for the milling head, this time perpendicular to the fifth axis.

CNC milling machines are traditionally programmed using a set of commands known as G-codes. G-codes represent specific CNC functions in alphanumeric format.

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption

The machine tool industries in this cluster use electricity from grid to meet their electrical energy requirement. Some of the industrial units having the backup power generator (Diesel Based) to meet the demand in case of grip power supply failure or scheduled power cut from the grid. The main and primary energy for machine tool industries is the electricity for operation of production and utility services. In manufacturing of some category of products, heat treatment process required to achieve the desired material properties. In heat treatment units of the clusters, which are very few in numbers (only 14 %) are using electricity as the main source of energy even in the process of heat treatment, which is usually outsourced. The percentage segregation of used energy in the cluster is given in figure 1.2, which reveals that the 95.9% of energy used in the cluster is drawn from the Bangalore Electricity Supply Company Limited (BESCOM) grid whereas only 4.1% of total energy required is being generated by thermal energy (High Speed Diesel) using DG sets.

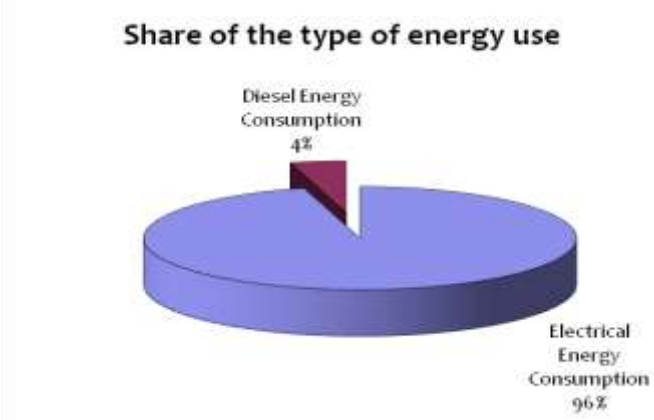


Figure 1.2: Share of Energy Type used in the Machine Tool Units

1.2.2 Average production

Production capacity of machine tool units in Bangalore cluster depends on the type of product being produced in unit. Production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum. The following figure shows the classification of machine tool units in Bangalore cluster based on production capacity. The production capacity as the weight of the metal removed in case of components, accessories and SPM making industries. In case of Heat treatment, weight of the material treated has been considered as the production capacity. The above methodology is adopted as major energy is spent towards removing the metal, as per the specifications of the product, while carrying out jobs such as milling, turning, grinding and drilling. In case of heat treatment units, major energy is spent in the heat treatment furnaces. Hence, the weight of material processed is taken as production capacity.

1.2.3 Specific energy consumption

The specific energy consumption depends on the final product being manufactured by the machine tool units; therefore SEC has been classified according to the types of products produced in the cluster. Details of the SEC depending on the type of products is shown in the following table

Table 1.1 Energy Consumption Pattern of Machine Tools Cluster

Type of units	Specific Energy Consumption, GJ/Tonne	Specific Energy Consumption, kWh/Tonne
Components	24.8	6472
Accessories	19.7	5118
Machines	2.2	600
Heat Treatment	64.2	15057
Average	27.7	6811.8

1.3 Identification of technology/equipment

The existing process or technology used in the cluster is mixed type. Some units are using 2 axis CNC machines and performing jobs in two or three steps for CNC Lathe Projects whereas some units also using the conventional machines which are completely depends on operators skills.

The existing technology required two or three times setup of the job on 2 – axis CNC machine and result in higher energy consumption and lower production rate. The error in product and material rejections also increased due the multiple setup requirements for a job.

1.3.1 Description of technology/equipment

The machine tools industry can be divided into metal cutting and metal forming sectors. The metal cutting sector can be further classified into conventional and computer numerically controlled (CNC) machines, while the metal forming sector can be segregated into conventional and numerically controlled (NC) machines. Some commonly used metal cutting machines include electrical discharge machining systems (EDMS), machining centers, lathes and automats, boring, milling, drilling, grinding, honing and polishing machines, total NC machines and so on. Metal forming machines include bending, folding, straightening, flattening machines, punching and/or shearing machines, die casting

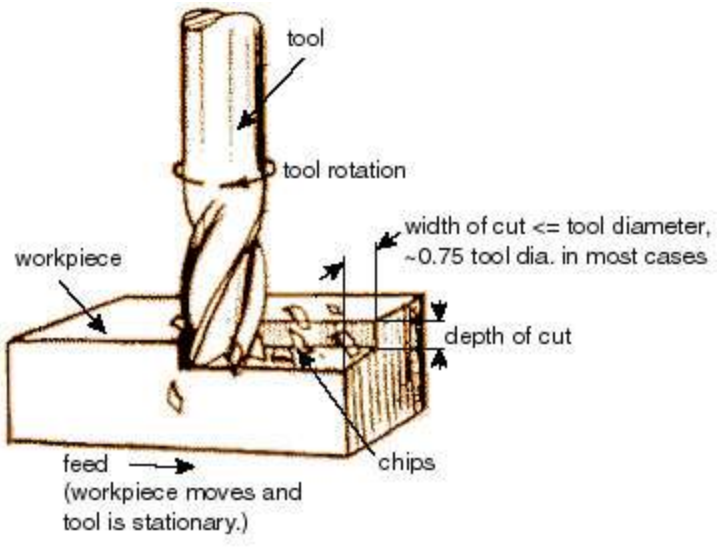
machines and others.

As with CNC turning centers, the Indian machine tools industry produces a range of CNC machining centers covering small to very large sizes. These machines are technologically more complex than turning machines. Typically, a CNC machining center has 3 linear movements, one rotary movement, apart from features such as tool changers, pallet changers etc. Indian machine tools meet the basic requirement of machining center operations, and a number of models are produced with both horizontal and vertical spindle configurations. Machines with spindle speeds of upto 10000 rpm, traverse rates of upto 60 mpm are produced by the Indian industry.

The current trend in machining centers is to have additional axes of movements to take on complex machining requirements (sometimes as many as 6 or 7), high traverse rates of 100 to 120 mpm, spindle speeds of 10000 to 50000 rpm, some turning and even grinding capabilities on the machining center. Internationally, machining centers are mostly built with at least 5 axes. Modern machines incorporate linear motors for high traverse rates, and integral motor spindles are universally used. At the simpler end of the product spectrum, machines are configured to occupy very small floor space suitable for line integration for mass production of auto components.

1.3.2 Role in process

Machining is a critical process in machine tools manufacturing industries. Design standards in all application areas are becoming increasingly more demanding. Expectations in terms of ergonomics, the air drag coefficient (CW value) or simply aesthetic appeal are creating a need for more complex surface geometries to be achieved in less time and with greater precision. The design primarily comes from CAD systems, the machining programs from CAM stations.



Nevertheless, the skilled machine tool operator still has overall responsibility (in terms of technology) for the quality of the mold and the complete tool.

Conventional machining, one of the most important material removal methods, is a collection of material-working processes in which power-driven machine tools, such as lathes, milling machines, and drill presses, are used with a sharp cutting tool to mechanically cut the material to achieve the desired geometry. Machining is a

part of the manufacture of almost all metal products, and it is common for other materials, such as wood and plastic, to be machined. A person who specializes in machining is called a machinist. A room, building, or company where machining is done is called a machine shop. Much of modern day machining is controlled by computers using computer numerical control (CNC) machining. Machining can be a business, a hobby, or both.

1.4 Benchmarking for existing specific energy consumption

The baseline data has been established based in the energy audits conducted in a total number of 30 machine units out of which 20 were preliminary audits and 10 were detailed audits. The total production cost estimated based on the various technology dependent cost of production of these units. It can be onserved that the total production cost is about ` 28374 per tonne and `3702814 annually.

Table 1.2 Energy Consumption Pattern of Existing Technology

Particular	*Unit*	*Value*
Specific Energy Consumption	kWh/Tonne	974.81
Average Energy Cost	Rs./Tonne	4874
Reduction in Rejection rate out of replacement by CNC machine/savings in Rs.	Rs,/tonne	13500
Other Cost (Man Power/Utility)	Rs./tonne	10000
Average Production cost	Rs./tonne	28374
Annual Production	Tonne	130.5
Annual Production Cost	Rs./annum	3702814

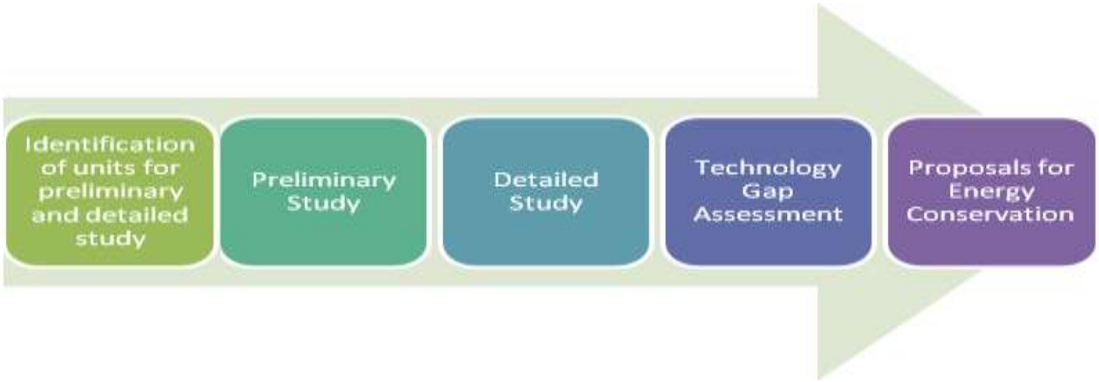
1.4.1 Design and operating parameters /specification

In present scenarion of the machine tools industries, machine cannot afford to breakdown, frequent change of the job settings and dependency on manpower since the investment cost of the machine is high. Each downtime is a lost for the investor. From economic point of view, in order to produce part at effective cost is by producing at high volume. Machine components become expensive which requires new type of maintenance to cater this problem.

1.4.2 Operating efficiency analysis

To determine the Energy use and technical study, individual units were identified within different locations of the Bangalore Machine Tools clusters in Bangalore district. It is integral to target different units in the clusters as it accounts for deviations in type of prudcts, job properties, sourcing of raw materials, and variations in manufacturing and housekeeping operations. The overall step by step methodology followed for Energy use and technical study is as below:

Figure 1.3 Energy auditing methodology



Preliminary energy study

The preliminary study is the first stage in conducting an energy and technology assessment of the machine tools manufacturing units in the cluster. The aim of the preliminary study is collecting information relating to production, machinery and energy use to get an overview of energy sources, raw materials, processes involved, etc of the units within the cluster. Preliminary energy studies were conducted at 30 machine tools manufacturing units in the Bangalore cluster and the time taken for each study was 1 – 2 days.

Detailed energy study

Detailed energy studies are conducted to get an in depth break up of energy usage of each of the associated processes in the machine tools manufacturing. It covers the quintessential steps in preliminary study and provides a thorough analysis of the functioning of units. Since electricity is the main source of energy used, there are some guidelines which need to be maintained while analyzing and measuring the electricity consumption pattern of the individual unit.

1.4.3 Specific fuel and electricity consumption

The main and basic energy used in the manufacturing process of machine tools is electricity in this unit. The liquid fuel (HSD) energy is mainly using to operate the diesel power generators during the power cut/non-availability of the electrical power from state electricity board.

1.5 Barriers for adoption of proposed technology/equipments

1.5.1 Technological Barrier

Technology obsolescence in the machine tool business is extremely rapid. Product lifecycles are declining and currently average life cycle is no more than 3 years! Thus, in a globalized India, SMEs have been and will continue to face challenges they have not seen

before. In the past, most of the products have been a result of 'Reverse Engineering'. Unlike the Japanese and Koreans, the Indian manufacturers have not graduated to the next level of 'Improving' the technology of reverse engineered products. Thus, product technology obsolescence is a major issue facing the Bangalore machine tools industry today. There is a definitive void in development and existing facilities for Research and Development in this sector. Institutes in the past have been integral in facilitating technology transfers and improvement in the machine tools manufacturing cluster all over India, However there is need for continuous Research and Development associated processes.

1.5.2 Financial Barrier

The restricted availability and the inability to raise resources are common to all types of small businesses. However, the machine tools sector, by its very nature, is a high financial outlay driven business. Average product costs are greater, gestation period of investments – longer, time to market – higher and a purchasing system – not yet fully matured. All this means greater, than most other businesses, financial resource requirement. This, in turn, puts the machine tool SMEs in a particular disadvantage.

1.5.3 Manpower Skill

Machine downtime ranged from 1 percent to as high as 20 percent in some cases. Labour efficiency ranged between 60 percent to 95 percent. Lower labour efficiency and labour utilization has manifested in lower employee productivity. Labour utilization has been lower as compared to other sectors because of surplus labour since only 26 percent of the companies have undergone downsizing and lack of awareness of productivity methodologies.

Only 65 percent of the companies used CNC or NC machines because most of the smaller players get almost 95 percent of their products outsourced and they only do assembling. In fact, as high as 17 percent of the companies get 100 percent of the manufacturing activities subcontracted. However, on an average 75 percent of the companies subcontracted some amount of their manufacturing. The subcontracting was mainly done due to capacity constraints followed by cost considerations.

1.5.4 Vendor Linkages:

No other business requires such complex level of vendor linkages as the machine tools. For materials, electrical, electronics, hydraulics, pneumatics, metallurgy, tribology, measurement controls – the list of myriad technology linkages is endless. This requires exceptional networking capabilities and plenty of time to be spent by owner of accompany/CEO himself.

2 TECHNOLOGY OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology selected

2.1.1 Description of technology

In new modern manufacturing industry, machine has become more efficient, complicated and fully automated. This type of new generation machines only required fewer man powers to operate because of automation functions. Thus this new feature, able to increase the volume of production but it requires new maintenance principles.

Products can be produced by modern technology, which uses computer software, hardware and firm ware in industries. It is needed to use CNC machine to get more accurate dimensions and irregular shape. So, CNC machines are becoming more and more important in modernized industrialization, it is required to convert these conventional lathe machines into semi automatic control lathe machine. Developing and changing into semi automatic control lathe machine, there are three required portions, namely, mechanical, electronics and mechatronics. From the mechanical point of view, the design of hydraulic circuit is dramatically needed. The functions of hydraulic circuits for semi automatic control lathe are analyzed in this paper. These consist of changing the tool, working the machining processes and locating the tool in turret. In this research paper, the hydraulic circuit design which can be changed four kinds of tools by using hydraulic motor is made and also constructed. The hydraulic circuit comprises vane pump, hydraulic motor, and two directional control valves for changing the tool; 4/3- way valve and 4/2-way valve. The transfer function of each component is derived and the whole system is analyzed

Conventional machines are machine tools for producing cylindrical, conical and flat surfaces. It can be used for drilling and boring holes which may be cylindrical or conical in shape. The basic engine lathe, one of the most widely used machine tools is very versatile when used by a skilled machinist. However, it is not particularly efficient when many identical parts must be machined as rapidly as possible. Numerical control is based on the use of numerical data for directly controlling the position of the operative units of a machine tool in machine operation. Today, a more popular adaptation of the basic process of NC is called Computer Numerical Control or CNC. Computer numerical control is the process of manufacturing machined parts using a computerized controller to command motors which drive each machine axis. In no field of engineering development has progress been so rapid in that of hydraulic operation. Therefore, hydraulic devices and control systems have become more and more important due to automation and mechanization. Similarly, in changing the tool in CNC machine, hydraulic is used to control the manufacturing processing of this machine.

Closed loop systems are very accurate. Most have an automatic compensation for error, since the feedback device indicates the error and the control makes the necessary adjustments to bring the slide back to its position. They use AC, DC or hydraulic servomotors. These various motors are mounted by hydraulic circuits or system. The term 'hydraulic circuit' is a group of components such as pumps, actuators, control valves, accumulators, restrictors, and pipelines.

2.1.2 CNC Machine operations

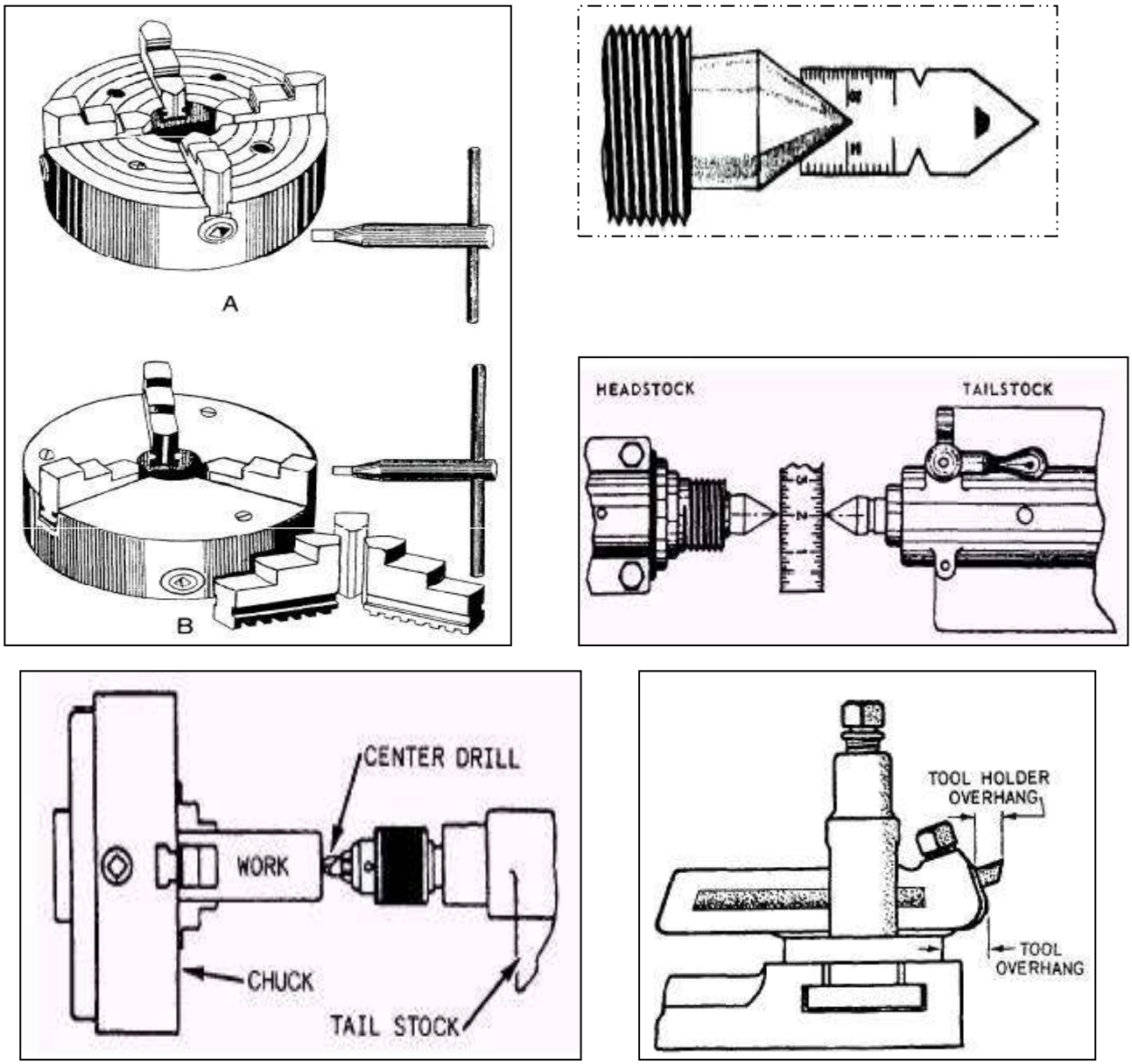


Figure 2.1 CNC Machine operations

Before starting a Turret lathe machining operation, always ensure that the machine is set up properly. If the work is mounted between centers, check the alignment of the dead center and the live center and make any necessary changes. Ensure that the tool holder and cutting tool are set at the proper height and angle. Check the work-holding accessory to ensure that the workpiece is held securely. Use the center rest or follower rest to support long workpieces. Preparing the centers the first step in preparing the centers is to see that they are accurately mounted in the headstock and tailstock spindles. The centers and the tapered holes in which they are fitted must be perfectly clean. Chips and dirt left on the contact surfaces prevent the bearing surfaces from fitting perfectly. This will decrease the accuracy of your work. Make sure that there are no burrs in the spindle hole. Holding the work you cannot perform accurate work if the workpiece is improperly mounted. The requirements for proper mounting are as follows:

- The work center line must be accurately centered along the axis of the lathe spindle.
- The work must be held rigidly while being turned.
- The work must NOT be sprung out of shape by the holding device.
- The work must be adequately supported against any sagging caused by its own weight and against springing caused by the action of the cutting tool.

There are four general methods of holding work in the lathe: (1) between centers, (2) on a mandrel, (3) in a chuck, and (4) on a faceplate. Work may also be clamped to the carriage for boring and milling, in which case the boring bar or milling cutter is held and driven by the headstock spindle. Other methods of holding work to suit special conditions are (1) one end on the live center or in a chuck and the other end supported in a center rest, and (2) one end in a chuck and the other end on the dead center. Holding Work Between Centers to machine a workpiece between centers, drill center holes in each end to receive the lathe centers. Secure a lathe dog to the workpiece. Then mount the work between the live and dead centers of the lathe. Centering the work to center round stock where the ends are to be turned and must be concentric with the unturned body, mount the work on the head spindle in a universal chuck or a draw-in collet chuck If the work is long and too large to pass through the spindle, use a center rest to support one end. Mount a center drill in a drill chuck in the tailstock spindle and feed it to the work by turning the tailstock handwheel

For center drilling a workpiece, the combined drill and countersink is the most practical tool. These combined drills and countersinks vary in size and the drill points also vary. Sometimes a drill point on one end will be 1/8 inch in diameter, and the drill point on the opposite end will be 3/16 inch in diameter. The angle of the center drill must always be 60° so that the countersunk hole will fit the angle of the lathe center point. If a center drill is not

available, center the work with a small twist drill. Let the drill enter the work a sufficient distance on each end; then follow with a 60° countersink.

In center drilling, use a drop or two of oil on the drill. Feed the drill slowly and carefully to prevent breaking the tip. Take extreme care when the work is heavy, because you will be less able to “feel” the proper feed of the work on the center drill. If the center drill breaks during countersinking and part of the broken drill remains in the work, you must remove this part. Sometimes you can drive the broken piece out by a chisel or by jarring it loose, but it may stick so hard that you cannot remove it this way. Then you must anneal the broken part of the drill and drill it out. We cannot overemphasize the importance of proper center holes in the work and a correct angle on the point of the lathe centers. To do an accurate job between centers on the lathe, you must ensure that the center-drilled holes are the proper size and depth and that the points of the lathe centers are true and accurate.

2.1.3 Technology specification

Table 2.1 Equipment Speciation

CNC Turret Lathe Machine		120 V – 60 Hz	220 V – 50 Hz
Power Requirement	**Current**	**3 A**	**1.5 A**
Lathe	Swing Over Bed	90 mm (3.5 in)	
	Center Height	101.6 mm (4 in)	
	Distance Between Centers	200 mm (8 in)	
	Swing Over Cross Slide	48 mm (1.9 in)	
	X-Axis Travel	47.8 mm (1.88in)	
	Z-Axis Travel	105.4 mm (4.15in)	
	Resolution	±0.00318 mm (±0.000125 in)	
Headstock	Spindle Bore	10 mm (0.405 in)	
	Spindle Taper	Morse No 1	
Tailstock	Tailstock Taper	Morse No. 0	
	Sleeve Stroke	38.1 mm (1.5 in)	
Main Spindle Drive	**Programmable Speed Range**	0-2800 r/min	
	Motor	160 W (0.21 hp), overload protected	
Feed Motors	Type	Stepper	
	Resolution	400 steps/r	
	Rapid Traverse Speed	356 mm/min (14 in/min)	

Accessories included	
Carbide Insert Tool with Tool Post	35E right-hand insert

Accessories included		
Carbide Tool Set with Tool Post	Types	AR4, AL4, BR4, BL4, C4 and E4
Null Modem Serial Cable	Length	3.05 m (10 ft)
	Connectors	DB9 female/female
TTL/IO Cable		
Ethernet Crossover Cable	**Length**	3.05 m (10 ft)
	Connectors	DB15 male/male
Set of Tools Content	**Length**	2.13 m (7 ft)
	Connectors	RJ45 male/male
Fuses	hex keys, cleaning brush, digital caliper and tool bag	
Physical Characteristics	**Current Rating**	1.0 A
	Voltage Rating	250 V
	Dimensions	(HxWxZ) 750x864x597 mm (29.5x34x23.5 in)

2.1.4 SUITABILITY OR INTEGRATION WITH EXISTING PROCESS

Depending on the user's needs, these lathes can function as a high precision manual lathe, a lathe with digital readout, a lathe with power feed and jog modes, a lathe with a TEACH mode for CNC turning or a lathe with full CNC capability. A frequency drive and servo drive provide infinitely variable speed and feed rate. The spindle speed automatically adjusts to varying diameters, giving the machine constant surface speed and the capability to deliver high accuracy, consistent repeatability and superior surface finish. These new generation lathes feature conversational & G-code control, heavier bed, more rigid tailstock design and a higher cam and worm gear ratio that ensure very smooth gear changes regardless of chuck or work piece weight. The spindle bore is machined in one setup to ensure perfect alignment at all times. Extensive tool path programming is no longer needed because of the machine's factory programmed machining cycles such as rough and finish passes, profiling, chamfering, grooving, threading, drilling and tapping. Tool compensation and gear change are automatic.

2.1.5 SUPERIORITY OVER EXISTING TECHNOLOGY

The CNC machines features a control panel that permits the lathe to be operated manually. This panel includes a multiple-line LCD display, an easy-to-use membrane keypad, an error indicator/pause button, and a key-released emergency stop push-button. The lathe parameters, including the spindle

speed, the feed rate, the reference point, and the X and Z axes coordinates of the cutting tool are adjusted by accessing different menus. During the turning, the control panel displays the X and Z axes coordinates of the cutting tool, the feed rate, and the spindle speed. The CNC machines are designed for maximum safety. A safety door provides protection during machining. Magnetic interlocks located on this door stop the spindle and the axes if the door is opened during machining. Limit switches prevent the bed from over-traveling and the cutting tool from crashing into the chuck. Pressing the emergency stop push-button on the control panel cuts off the power to the spindle motor and stops the axes. The CNC machines support low-voltage communications with robotic units. For this purpose, the CNC Lathe features a 15-pin TTL/IO port providing four 5-V digital input and four 5-V digital output lines for TTL communication to an automation work cell. The CNC machines also features a 5-pin solenoid driver port providing connections for up to four auxiliary devices. The TTL/IO and solenoid driver ports are M code supported through the CNC operating Software.

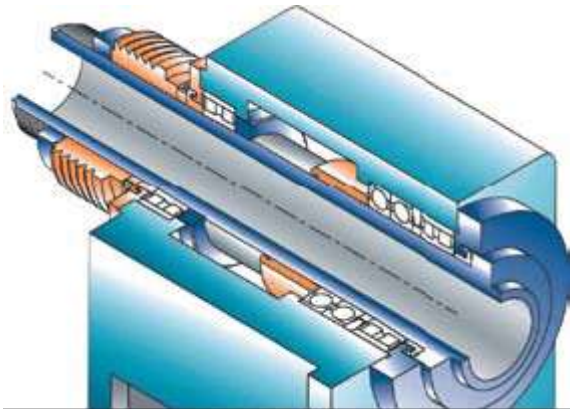
- Rigid bed construction
- Pretension ball screw that minimizes
- Thermal displacement
- Overload protection on X, Z-axis traverse
- Hydraulic chuck accompanied with both Hard
- Modular design with many options for cost effective combination of bar feeder, parts catcher, tool presetter, bar puller, etc.
- Automatic lubrication system
- High pressure coolant supply system

CNC Controller

The HL series comes standard equipped with a choice of a state-of-the-art controller like this FANUC CNC controller.

Precision Spindle

The heavy duty precision spindle has cylindrical roller bearings combined with angular thrust ball bearings designed to sustain radial as well as thrust loads.



The tool presetter reduces setup time with 4 point contact of each tool with the measuring sensor.

2.1.6 Availability of technology

CNC based technology providers are basically multinational companies providing the services in all the major cities of the country. The technology is widely available and lots of national and multinational manufacturers are suppling their products to these industries including the machine tools industry.

2.1.7 Source of technology

This technology is already in use in some machine tools units in the cluster where the production requirment is same. They also got the results of reduction in energy consumption as well as reduction in rejection of material and the technology is running successfully.

2.1.8 Service/technology providers

There are about 5 technology providers are available in the cluster for this system including Ace Micromatic Machine Tools Pvt. Ltd., Haas Automation, Jyoti CNC automation Pvt. Ltd., DMG Mori Seiki India Machines and Services Pvt. Ltd. And Mazak company is the service provider for this technology. They have the experience in supplying the multi – axis machine and provided consultancy & implementation support. The detailed contact information of all service providers is provided in annexure - .

2.1.9 Terms and condition of sales

Sales and after implementation of technology support information is provided in the annexure.

2.1.10 Process down time during implementation

The installation of CNC machines can be done in the 10 – 14 days, However the CNC machine is end to end solution of machining production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

2.2 Life cycle assessment and risks analysis

In case installation of CNC machine, the technology and machine will continue to work up to 12 to 17 years under proper maintains. No need to any further huge modification after one time installation, in case of risk analysis there is a need of proper maintains and timely oiling.

2.3 Suitable unit/plant for implementation of proposed technology

CNC machine is suitable for the units involved in the production of more fast machining than conventional machines hense increase in productivity and Quality of the product is defenitely enhanced. Here The refference is taken of **M/S Sadbhava Fabricators private limited Bangalore Karnataka**

3 ECONOMIC BENEFITS FROM NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel saving

CNC Machines are rapidly replacing the older production lathes (multispindle, etc) due to their ease of setting and operation. They are designed to use modern carbide tooling and fully utilize modern processes. The part may be designed by the Computer-aided manufacturing (CAM) process, the resulting file uploaded to the ma chine, and once set and trialled the machine will continue to turn out parts under the occasional supervision of an operator. The machine is controlled electronically via a computer menu style interface, the program may be modified and displayed at the machine, along with a simulated view of the process. The setter/operator needs a high level of skill to perform the process, however the knowledge base is broader compared to the older production machines where intimate knowledge of each machine was considered essential. These machines are often set and operated by the same person, where the operator will supervise a small number of machines (cell). And saving capacity of the producting unit is enhanced without effecting the annual production of the unit.The design of a CNC Machines has evolved yet again however the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed. The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues. Installation of CNC machine is the ability to machine complex shapes in a single setup. This reduces the machinist setup time and incerease the production rate. The main advantage of CNC machining is the ability to save time by machining complex shapes in a single set-up. Additional benefit comes from allowing the use of shorter cutters that permit more accurate machining. Energy & Cost saving including the energy, material rejection, man power cost and utility cost for a typical unit by installation of CNC machine are tabulated below:

Table 3.1 Energy savings estimation for CNC machine

S. No	*Particular*	*Unit*	*Conventional machines*	*CNC machines*
1	Specific Energy Consumption	kWh/Tonne	974.81	779.85
2	Average Energy Cost	`/Tonne	4874.05	3899.25
3	Cost of Material Rejection	`/Tonne	13500	10210.5
4	Other Cost (Man Power/Utility)	`/Tonne	10000	8000
5	Average Production	`/Tonne	28374.1	22109.75
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/Tonne	3702814	2885322
8	Reduction in Production Cost	`/Tonne		6264.3

S. No	Particular	Unit	Conventional machines	CNC machines
9	Annual cost reduction	`/Tonne		817491

A CNC machine will not only reduce the operartional cost of production but also increase the rate of the production in the same time. The estimated or feedback received from amny users of CNC machine revels that the CNC machine may produce two times production/ material at same time and at same energy consumption. The CNC machines gives us the annual savings of ` 8.18 lakh annually and of ` 6264 per Tonne produced

***Note:-** *As in the proposed DPR Conventional machine is replaced by CNC Machine, it is assumed that it improves the overall productivity by 1.75 times i.e. 130.5 Tonnes/Annum in earlier case to 228.375 Tonnes/Annum after implementation. Accordingly, the energy saving could be achieved.Consequnetly, the O&M cost of machinery shall increase to 5 % with annual Escalation of 5 %.*

3.1.2 Improvement in product quality

CNC machine is presently one of the most versatile machine tools available and they are becoming increasingly common. This machening not only improve the quality of the product which is totly desinged by CNC machine with comparision to the exisitng manual set up based product. The rejection of material in CNC machining is almost nill while comparing with existing system/technology. Finally, high-speed cutting parameter coordination is executed by a CNC cycle for easy set-up and user-friendly activation of advanced motion control features. Excessive programming time is eliminated, because the adaptation of the CNC set-up is done according to the particular machining technique being employed.

The parts conveyor permits for efficient parts collection and unmanned operation.

3.1.3 Increase in production

A CNC machine will not only reduce the operartional cost of production but also increase the rate of the production in the same time. The estimated or feedback received from amny users of Conventional lathe machine machines revels that the CNC machine may produce two times production/ material at same time and at same energy consumption.

3.1.4 Reduction in raw material consumption

The rejection of material in CNC machining is almost nill while comparing with existing

system/technology. However, in the cost calculation about 40% of the existing rate of rejection is considered.

3.1.5 Reduction in other losses

Installation of CNC machine will result in reduction of the utility system like compressed air system to operate the numetic system and other general utility expanses due to fast rate of the production with comparision to the existing technology. Some of them are listed below:-

- The automatic lubricator delivers 3~6cc of lubricant in 15 minute intervals to both slide ways and ball screws.
- The precision ball screw is pretension to minimize thermal displacement.
- The hydraulic power system provides stable and powerful hydraulic pressure for the machine.
- The chain-type chip conveyor automatically removes chips from the machining environment allowing for non-stop operation.

3.2 Monetary benefits

Monetary savings in a typical unit after installation of CNC machine has been estimated around `6264.3 and `14.31 lakh per annum. This figure has been arrived based on the annual reduction in energy, rate of material rejection and manpower cost savings in a typical unit multiplied by average annual production of the unit.

3.3 Social benefits

3.3.1 Improvement in working environment

The design of a CNC machines has evolved yet again however the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed. The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues.With the advent of cheap computers, free operating systems such as Linux, and open source CNC software, the entry price of CNC machines has plummeted.

3.3.2 Improvement in skill

Intervention of any new technology in any process/ industry requires improvement in skill set of workforce so as to run the process efficiently. This will also provide the development of skill sets of operators for CNC which will lead to energy efficient operations and quality product.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

As the existing and proposed technology is based on the low energy conservation and

maximum output with saving of fuel and eletricity, hense saving nature and producing low carbon output per tonne.

3.4.2 Reduction in GHG emission such as CO_2, NOx, etc

There are significant reductions to be achieved in Green House Gas emission by adoption of advance CNC technology like CNC machines in machine tools industries. Reduction in electricity consumption translates into GHG reductions is estimated to be 33.4 tonne of CO_2 per annum for given energy saving and production.

3.4.3 Reduction in other emissions like SOx

As the existing and proposed technology is based on the clean fuel based operation therefore Sulphur is not present in electricity; hence there is no impact on SO_X emissions.

4 IMPLEMENTATION OF NEW ENERGY EFFICIENT TECHNOLOGY

4.1 Cost of technology implementation

4.1.1 Cost of technology

The costs of equipments that will be required for Installation of CNC machine are provided in Table 4.1 below:

Table 4.1 Cost of equipment

S. No.	Particulars	Cost
1	Cost of CNC machine	`3573000

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

S. NO.	Particulars	Cost
1.	Packaging & Forwarding	`197,000/-
2.	Cost of civil work	`45,000/-
3.	Cost of Consultancy and installation	`65,000/-
Total	**Rupees three lakh seventeen thousand only/-**	**`317,000/-**

Total investment in the proposed technology (including equipment cost & Other cost) is ` 38.80 lakh.

4.2 Arrangements of funds

Proposed financing for the replacement of Conventional lathe with CNC Lathe is made considering a debt equity ratio of 3:1, which is normally allowed by financial institutions for financing energy efficiency projects. On the basis of debt equity ratio of 3:1 the promoter's contribution works out to 25% of the project cost and the balance would be term loan from the Bank / FIs.

4.3 Financial indicators

4.3.1 Cash flow analysis

Detail cash flow analysis for new proposed technology is given in Annexure–5.

4.3.2 Simple payback period

The estimated payback period is about 2.71 years.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 25.66 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 23.43%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 21.11 %.

Table 4.4 Financial indicator of proposed technology

Particulars	Unit	Value
Simple Pay Back period	Years	2.71
IRR	%age	23.43
NPV	` in lakh	25.66
ROI	%age	21.11
DSCR	ratio	1.69

4.4 Sensitivity analysis

In different situation energy saving may increase or decrease on the basis of this scenarios a sensitivity analysis in realistic, pessimistic and optimistic has been carried out on the basis of two scenarios as considers.

Fuel saving increase by 5%

Fuel saving decrease by 5%

Table 4.5: Sensitivity analysis

Particulars	IRR	*NPV*	ROI	DSCR
Normal	23.43%	25.66	21.11	1.69
5% increase in fuel savings	23.68%	26.15	21.15	1.71
5% decrease in fuel savings	23.18%	25.18	21.06	1.68

Assuming all provision and resource input would be similar during economic analysis

4.5 Procurement and implementation schedule

The installation of CNC machine can be done in the 8 weeks, Details provided below. However the CNC machine is end to end solution of CNC machineing production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

Table 4.6: Implementation Schedule

S. No.	Activities	Weeks							
		1	2	3	4	5	6	7	8
1	Procurement and Delivery								
2	Civil & Electrical Work								
3	Commissioning								
4	Training								

ANNEXURE

Annexure 1: Energy audit reports used for establishing

The results of detail energy audit for a Bangalore Machine tool cluster production units with specefic energy consuption are given below:

Audit No. 1

Particular	*Unit*	*Value*
Specific Energy Consumption	kWh/Tonne	974.81
Average Energy Cost	`/Tonne	4874.05
Cost of Material Rejection	`,/tonne	13500
Other Cost (Man Power/Utility)	`/tonne	10000
Average Production cost	`/tonne	**28374.1**
Annual Production	Tonne	130.5
Annual Production Cost	`/annum	**3702814**

Monetary savings Calculations

S. No	*Particular*	*Unit*	*Conventional machines*	*CNC machines*
1	Specific Energy Consumption	kWh/Tonne	974.81	779.85
2	Average Energy Cost	`/Tonne	4874.05	3899.25
3	Cost of Material Rejection	`/Tonne	13500	10210.5
4	Other Cost (Man Power/Utility)	`/Tonne	10000	8000
5	Average Production	`/Tonne	28374.1	22109.75
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/Tonne	3702814	2885322
8	Reduction in Production Cost	`/Tonne		6264.3
9	Annual cost reduction	`/Tonne		817491

***Note:-** *As in the proposed DPR Conventional machine is replaced by CNC Machine, it is assumed that it improves the overall productivity by 1.75 times i.e. 130.5 Tonnes/Annum in earlier case to 228.375 Tonnes/Annum after implementation. Accordingly, the energy saving could be achieved.Consequnetly, the O&M cost of machinery shall increase to 5 % with annual Escalation of 5 %.*

S. No	Particular	Unit	Conventional machines	CNC machines
1.	Average Production	` /tonne	28374.1	22109.75

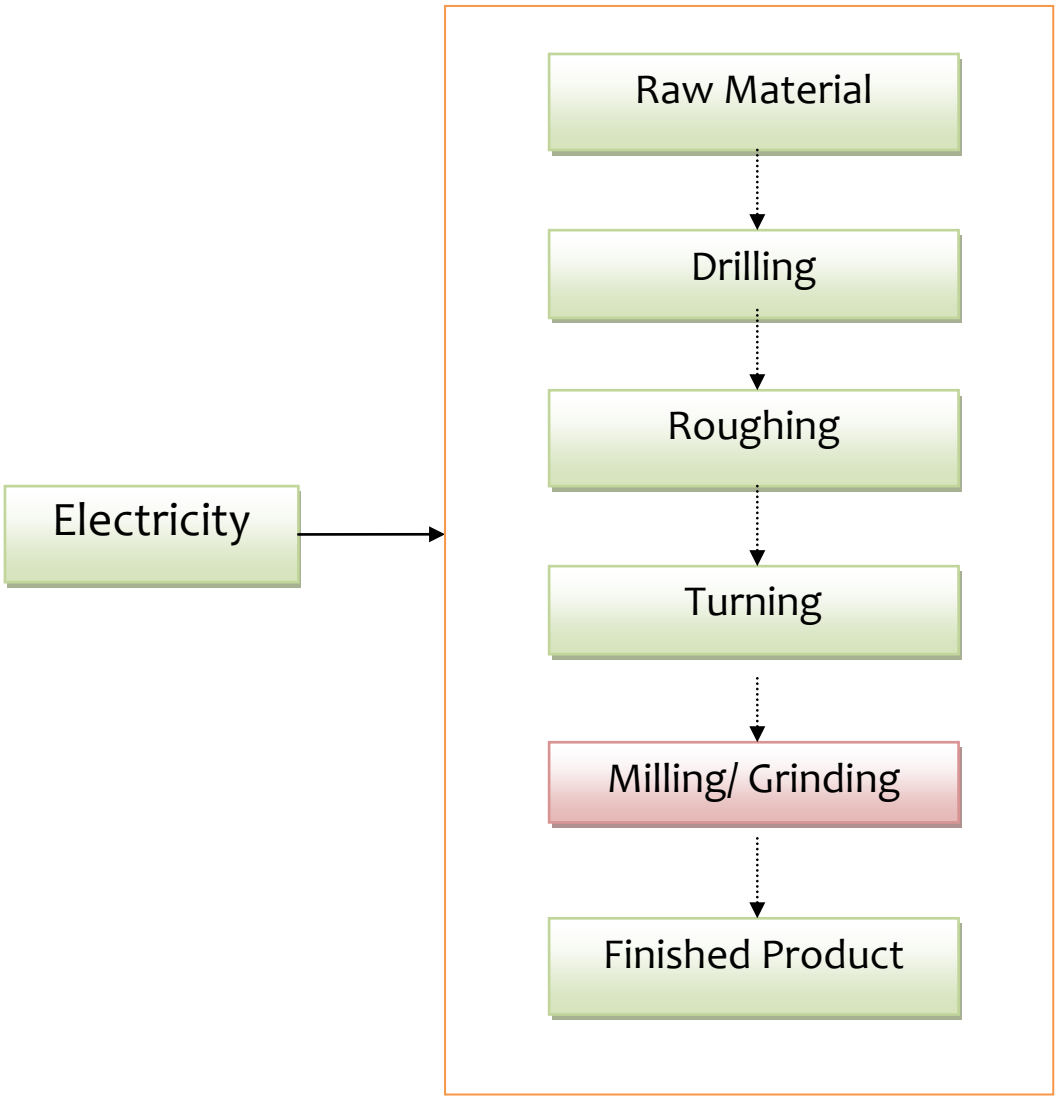
S. No	Particular	Unit	Conventional machines	CNC machines
2.	Annual Production	Tonne/annum	130.5	228.375
3.	Annual Production Cost	` /annum	3702814	5049372
4.	Annual cost reduction	` /Annum		1430610

****** This monetary savings are due increase in production of the unit by 1.75 times the existing.* ***(6264.3 x 228.375 = 1430610)***

- ✓ ***6264.3*** savings in` per tonne
- ✓ ***228.375*** Increased production in tonnes

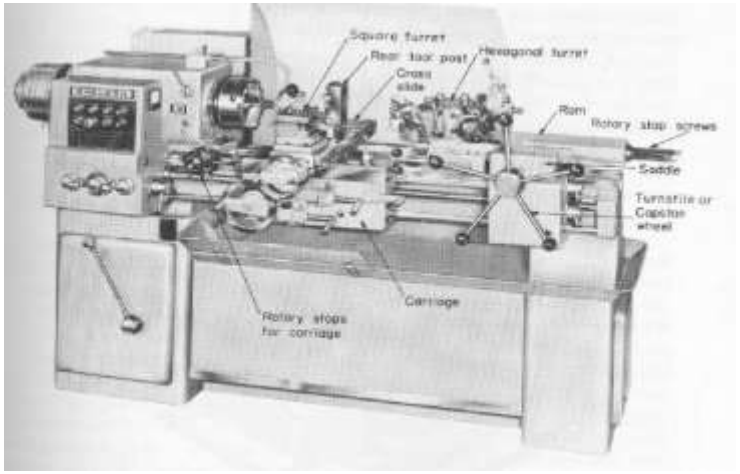
Annexure 2: Process flow diagram

CNC machine is end to end solution for CNC machining process in machine tools manufacturing units. Lathe machine computerized numerical control (CNC) machines have become the application of choice for complex surface machining. These machine tools are widely used in the aerospace, automotive, tool and die making and other industries requiring complex shapes.

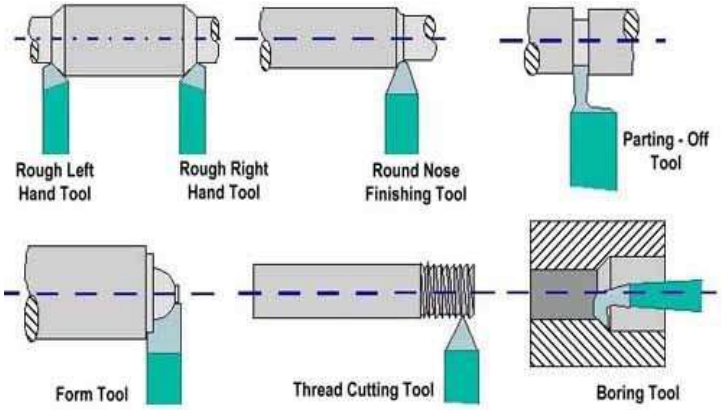


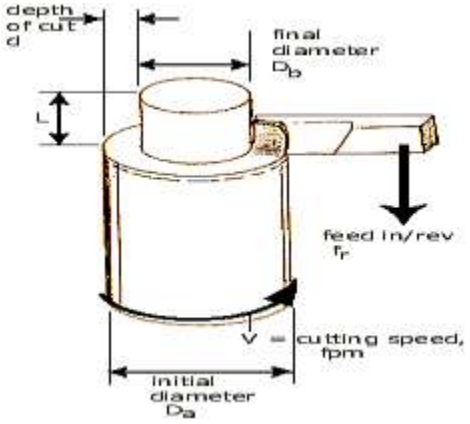
Annexure 3: Technical Drawing of CNC Turret lathe machine

Turret lathe and capstan lathe

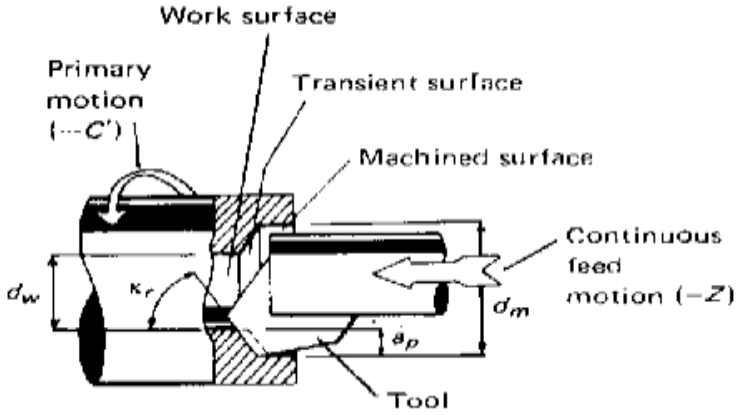


CUTTING TOOLS FOR LATHES

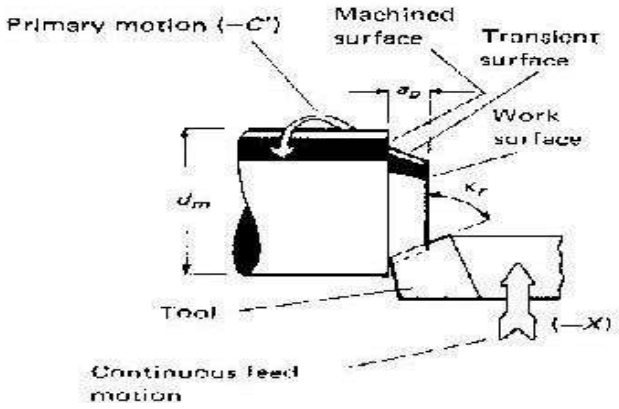




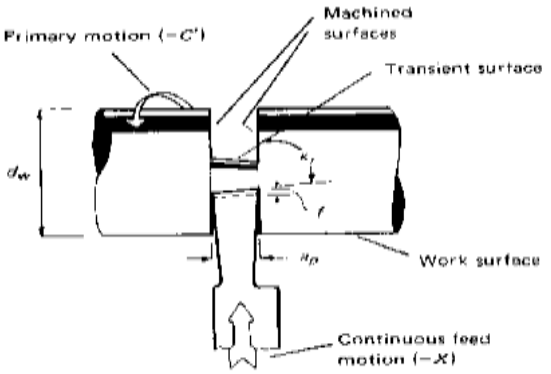
Facing

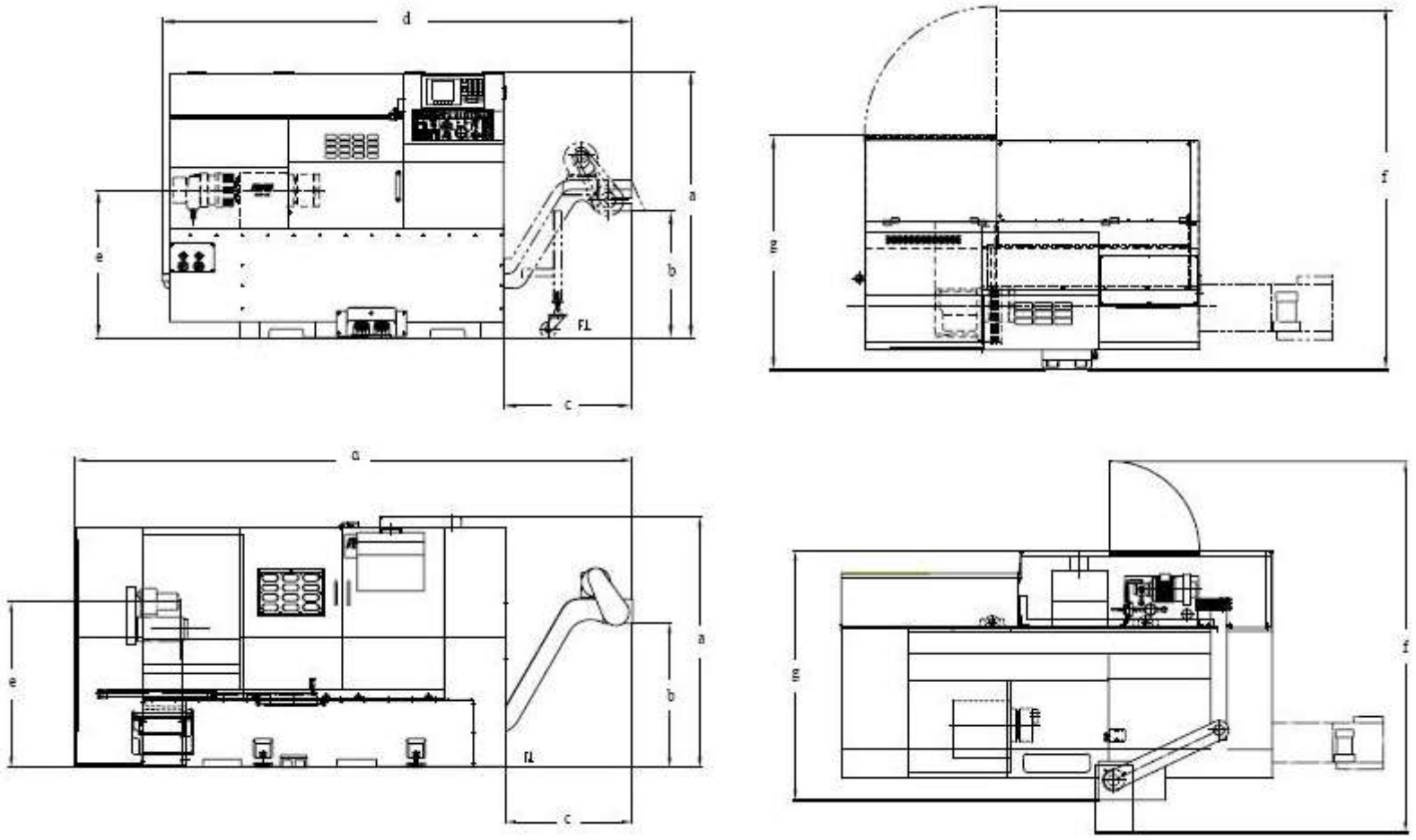


Facing

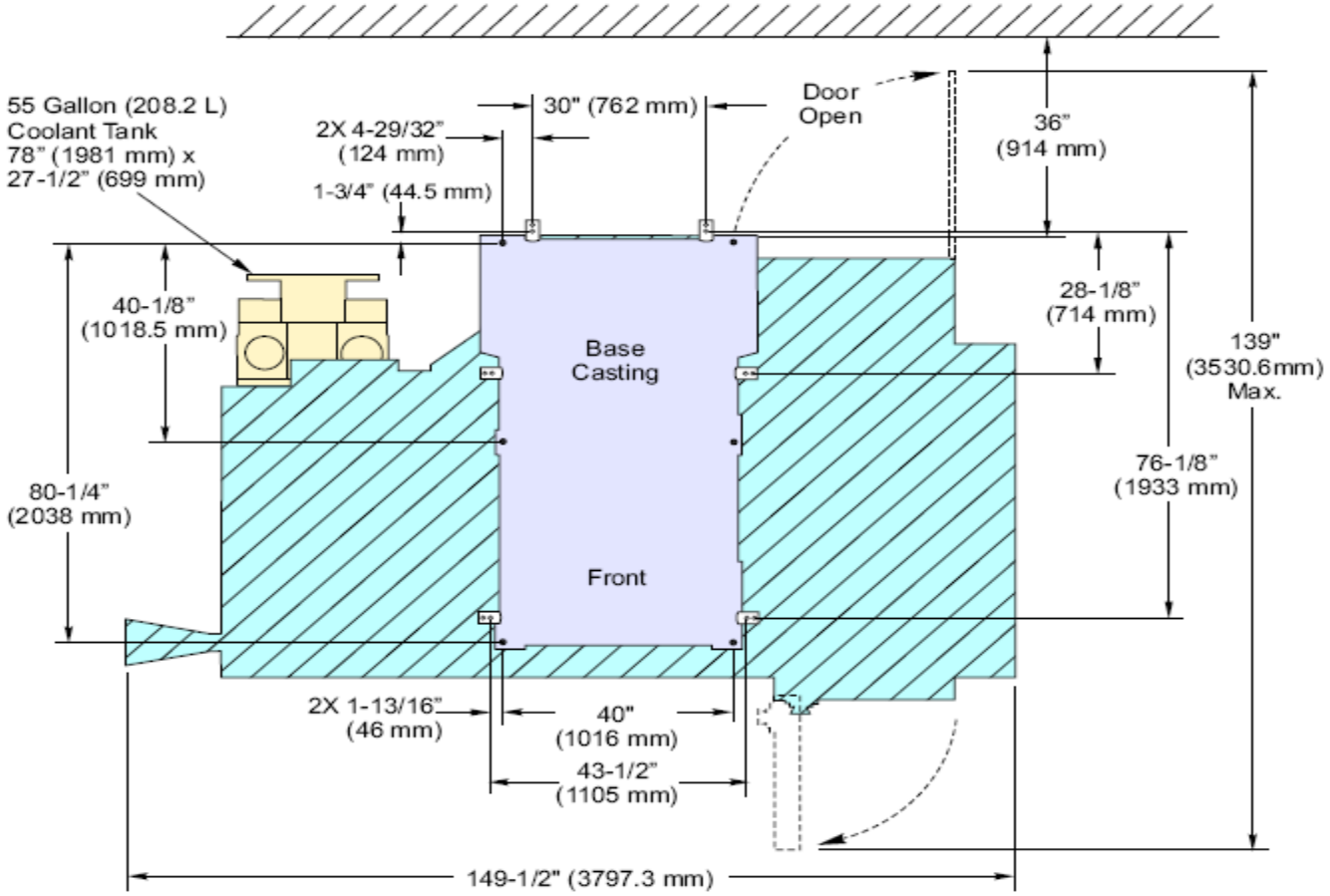


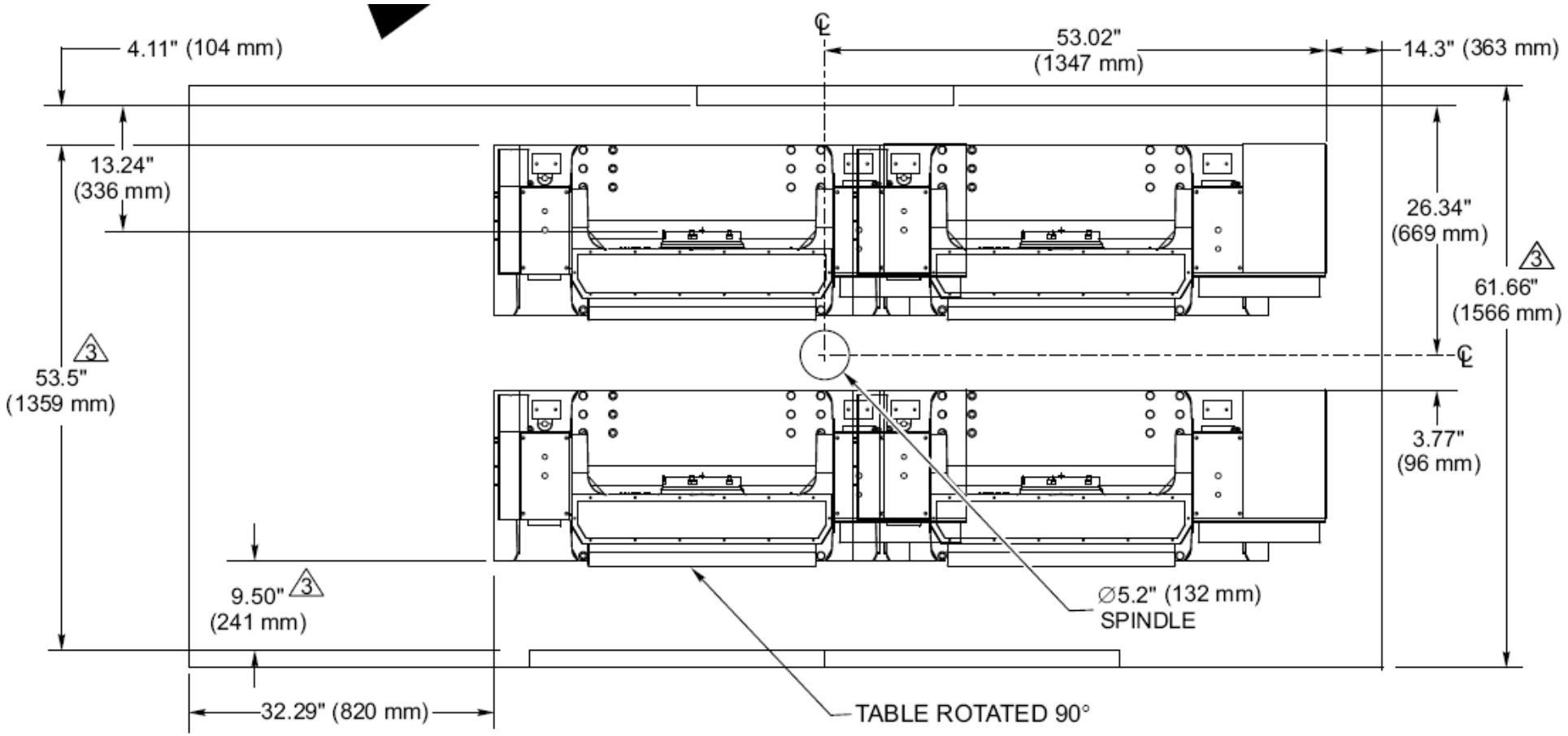
Parting

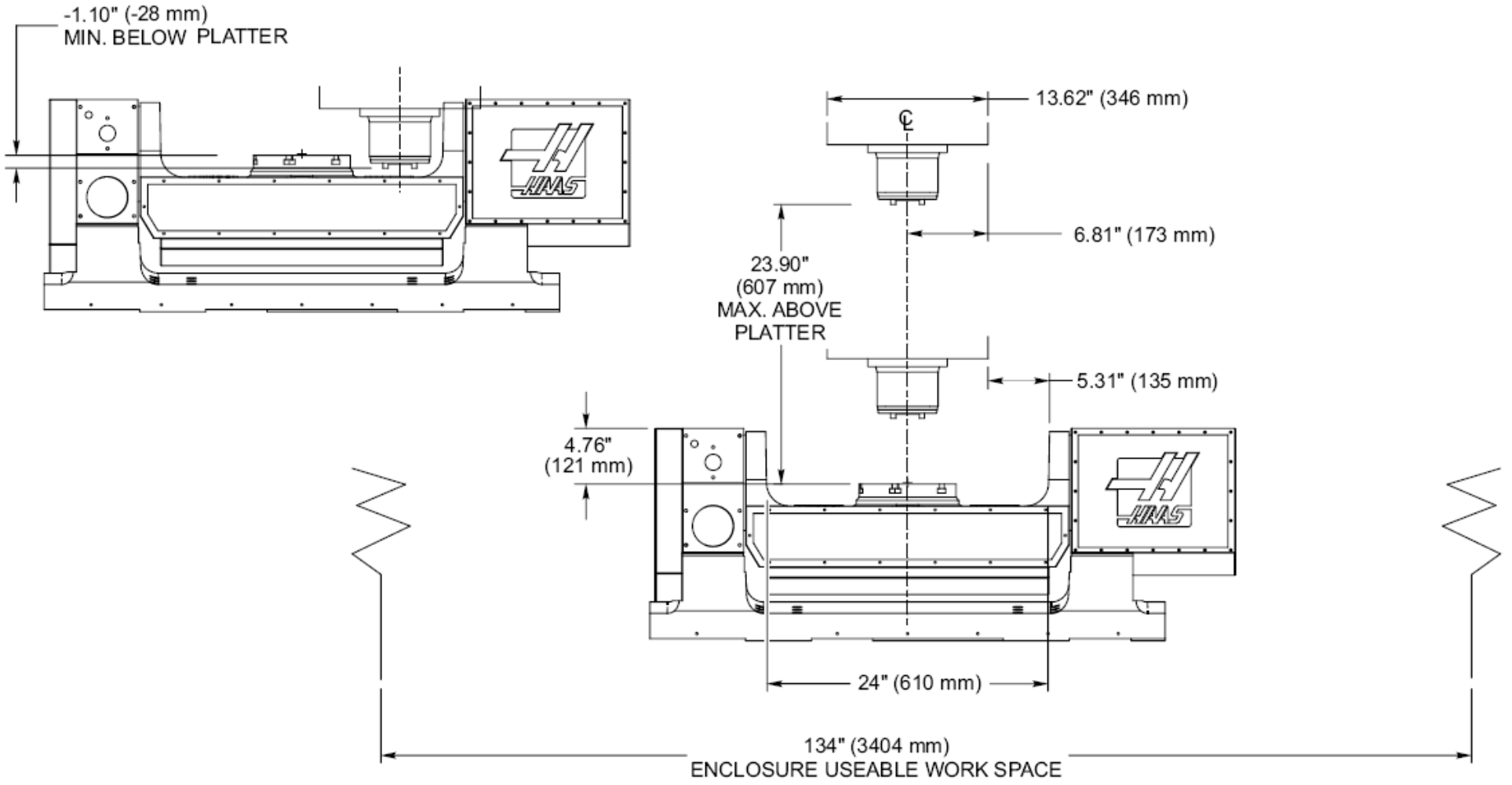




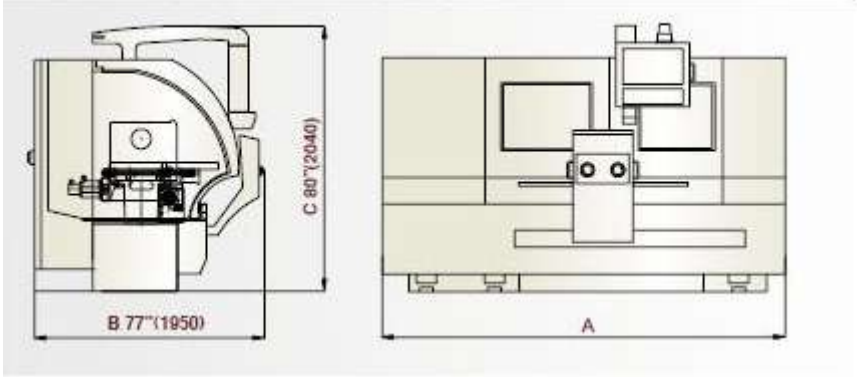
Sketch of the CNC Turret Lathe Machine (Shipping Model)


55 Gallon (208.2 L)
Coolant Tank
78" (1981 mm) x
27-1/2" (699 mm)
2X 4-29/32"
(124 mm)
1-3/4" (44.5 mm)
30" (762 mm)
Door
Open
36"
(914 mm)
40-1/8"
(1018.5 mm)
Base
Casting
28-1/8"
(714 mm)
139"
(3530.6mm)
Max.
80-1/4"
(2038 mm)
76-1/8"
(1933 mm)
Front
2X 1-13/16"
(46 mm)
40"
(1016 mm)
43-1/2"
(1105 mm)
149-1/2" (3797.3 mm)

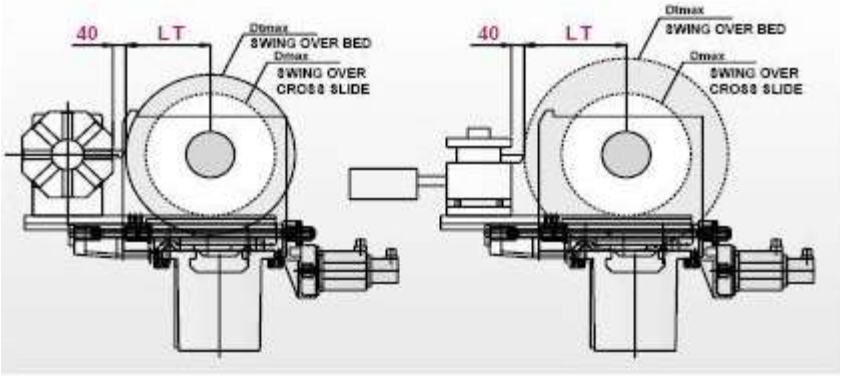

4.11" (104 mm)
53.02"
(1347 mm)
14.3" (363 mm)
13.24"
(336 mm)
26.34"
(669 mm)
3
61.66"
(1566 mm)
3
53.5"
(1359 mm)
3.77"
(96 mm)
9.50"
(241 mm)
3
∅5.2" (132 mm)
SPINDLE
32.29" (820 mm)
TABLE ROTATED 90°


-1.10" (-28 mm)
MIN. BELOW PLATTER
13.62" (346 mm)
6.81" (173 mm)
23.90"
(607 mm)
MAX. ABOVE
PLATTER
5.31" (135 mm)
4.76"
(121 mm)
24" (610 mm)
134" (3404 mm)
ENCLOSURE USEABLE WORK SPACE

GENERAL DIMENSIONS



MAX. TURNING DIAMETER



Annexure 4: Detailed financial calculations & analysis for financial indicators

Assumption

Name of the Technology	*CNC Lathe Machine*		
Rated Capacity			
Details	*Unit*	*Value*	*Basis*
No of working days	Days	300	Feasibility Study
No of Shifts per day	Shifts	2	Feasibility Study
Proposed Investment			
Plant & Machinery	` (in lakh)	35.73	
Packaging & forwarding	` (in lakh)	1.97	
Cost of modification in civil construction	` (in lakh)	0.45	Feasibility Study
Cost of consultancy	` (in lakh)	0.65	Feasibility Study
Total Investment	` (in lakh)	38.80	Feasibility Study
Financing pattern			
Own Funds (Equity)	` (in lakh)	9.70	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	29.10	Feasibility Study
Loan Tenure	years	7	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	90	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity Saving	kWh/Tonne	194.96	
Annual production	Tonne/Annum	228.375	
Cost	`/kWh	5	
Other savings	`/ Tonne	5289.5	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan *(`in lakh)*

Years	Opening Balance	Repayment	Closing Balance	Interest
1	29.10	1.20	27.90	3.38
2	27.90	2.40	25.50	2.68
3	25.50	2.80	22.70	2.43
4	22.70	3.80	18.90	2.11
5	18.90	4.80	14.10	1.69
6	14.10	5.40	8.70	1.16
7	8.70	5.60	3.10	0.62
8	3.10	3.10	0.00	0.09
		29.10		

WDV Depreciation

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	38.80	7.76
Depreciation	31.04	6.21

Particulars / years	1	2
WDV	7.76	1.55

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Revenue through Savings										
Total Revenue (A)	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31
Expenses										
O & M Expenses	1.94	2.04	2.14	2.25	2.36	2.48	2.60	2.73	2.87	3.01
Total Expenses (B)	1.94	2.04	2.14	2.25	2.36	2.48	2.60	2.73	2.87	3.01
PBDIT (A)-(B)	12.37	12.27	12.17	12.06	11.95	11.83	11.71	11.58	11.44	11.30
Interest	3.38	2.68	2.43	2.11	1.69	1.16	0.62	0.09	-	-
PBDT	8.99	9.59	9.74	9.95	10.26	10.67	11.08	11.48	11.44	11.30
Depreciation	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
PBT	6.94	7.54	7.69	7.90	8.21	8.62	9.04	9.44	9.39	9.25
Income tax	-	1.15	3.31	3.38	3.49	3.63	3.77	3.90	3.89	3.84
Profit after tax (PAT)	6.94	6.39	4.38	4.52	4.72	4.99	5.27	5.53	5.50	5.41

Computation of Tax ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Profit before tax	6.94	7.54	7.69	7.90	8.21	8.62	9.04	9.44	9.39	9.25
Add: Book depreciation	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Less: WDV depreciation	31.04	6.21	-	-	-	-	-	-	-	-
Taxable profit	(22.05)	3.38	9.74	9.95	10.26	10.67	11.08	11.48	11.44	11.30
Income Tax	-	1.15	3.31	3.38	3.49	3.63	3.77	3.90	3.89	3.84

Projected Balance Sheet

`(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Liabilities										
Share Capital (D)	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70
Reserves & Surplus (E)	6.94	13.33	17.71	22.23	26.95	31.94	37.21	42.74	48.25	53.65
Term Loans (F)	27.90	25.50	22.70	18.90	14.10	8.70	3.10	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	44.54	48.53	50.11	50.83	50.75	50.34	50.01	52.44	57.95	63.35
Assets										
Gross Fixed Assets	38.80	38.80	38.80	38.80	38.80	38.80	38.80	38.80	38.80	38.80
Less: Accm. Depreciation	2.05	4.10	6.15	8.19	10.24	12.29	14.34	16.39	18.44	20.49
Net Fixed Assets	36.75	34.70	32.65	30.60	28.56	26.51	24.46	22.41	20.36	18.31
Cash & Bank Balance	7.79	13.83	17.45	20.22	22.19	23.83	25.55	30.03	37.58	45.04
Total Assets	44.54	48.53	50.11	50.83	50.75	50.34	50.01	52.44	57.95	63.35
Net Worth	16.64	23.03	27.41	31.93	36.65	41.64	46.91	52.44	57.95	63.35
Dept equity ratio	2.88	2.63	2.34	1.95	1.45	0.90	0.32	0.00	0.00	0.00

Projected Cash Flow: ***`(in lakh)***

Particulars / Years	0	1	2	3	4	5	6	7	8	9	10
Sources											
Share Capital	9.70	-	-	-	-	-	-	-	-	-	-
Term Loan	29.10										
Profit After tax		6.94	6.39	4.38	4.52	4.72	4.99	5.27	5.53	5.50	5.41
Depreciation		2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Total Sources	38.80	8.99	8.44	6.43	6.57	6.77	7.04	7.32	7.58	7.55	7.46

Application											
Capital Expenditure	38.80										
Repayment of Loan	-	1.20	2.40	2.80	3.80	4.80	5.40	5.60	3.10	-	-
Total Application	38.80	1.20	2.40	2.80	3.80	4.80	5.40	5.60	3.10	-	-
Net Surplus	-	7.79	6.04	3.63	2.77	1.97	1.64	1.72	4.48	7.55	7.46
Add: Opening Balance	-	-	7.79	13.83	17.45	20.22	22.19	23.83	25.55	30.03	37.58
Closing Balance	-	7.79	13.83	17.45	20.22	22.19	23.83	25.55	30.03	37.58	45.04

Calculation of Internal Rate of Return ***`(in lakh)***

Particulars / months	0	1	2	3	4	5	6	7	8	9	10
Profit after Tax		6.94	6.39	4.38	4.52	4.72	4.99	5.27	5.53	5.50	5.41
Depreciation		2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Interest on Term Loan		3.38	2.68	2.43	2.11	1.69	1.16	0.62	0.09	-	-
Cash outflow	(38.80)	-	-	-	-	-	-	-	-	-	-
Salvage value											18.31
Net Cash flow	(38.80)	12.37	11.12	8.86	8.68	8.46	8.20	7.94	7.67	7.55	25.77
IRR	23.23%										
NPV	24.89										

Break Even Point ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Variable Expenses										
Operation & Maintenance Exp (75%)	1.45	1.53	1.60	1.68	1.77	1.86	1.95	2.05	2.15	2.26
Sub Total (G)	1.45	1.53	1.60	1.68	1.77	1.86	1.95	2.05	2.15	2.26
Fixed Expenses										
Operation & Maintenance Exp (25%)	0.48	0.51	0.53	0.56	0.59	0.62	0.65	0.68	0.72	0.75
Interest on Term Loan	3.38	2.68	2.43	2.11	1.69	1.16	0.62	0.09	0.00	0.00
Depreciation *(H)*	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Sub Total (I)	5.91	5.24	5.01	4.72	4.33	3.83	3.32	2.82	2.77	2.80
Sales (J)	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31	14.31
Contribution (K)	12.85	12.78	12.70	12.62	12.54	12.45	12.36	12.26	12.16	12.05
Break Even Point (L= G/I) (%)	46.01%	40.99%	39.46%	37.40%	34.52%	30.78%	26.87%	23.03%	22.75%	23.25%
Cash Break Even {(I)-(H)} (%)	30.07%	24.96%	23.33%	21.17%	18.18%	14.32%	10.29%	6.32%	5.89%	6.24%
Break Even Sales (J)*(L)	6.58	5.86	5.65	5.35	4.94	4.40	3.84	3.30	3.25	3.33

Return on Investment ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Net Profit Before Taxes	6.94	7.54	7.69	7.90	8.21	8.62	9.04	9.44	9.39	9.25	84.01
Net Worth	16.64	23.03	27.41	31.93	36.65	41.64	46.91	52.44	57.95	63.35	397.95
ROI	21.11%										

Debt Service Coverage Ratio ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow											

Profit after Tax	6.94	6.39	4.38	4.52	4.72	4.99	5.27	5.53	5.50	5.41	42.74
Depreciation	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	16.39
Interest on Term Loan	3.38	2.68	2.43	2.11	1.69	1.16	0.62	0.09	0.00	0.00	14.17
Total (M)	12.37	11.12	8.86	8.68	8.46	8.20	7.94	7.67	7.55	7.46	73.30

Debt

Interest on Term Loan	3.38	2.68	2.43	2.11	1.69	1.16	0.62	0.09	0.00	0.00
Repayment of Term Loan	1.20	2.40	2.80	3.80	4.80	5.40	5.60	3.10	0.00	0.00
Total (N)	4.58	5.08	5.23	5.91	6.49	6.56	6.22	3.19	0.00	0.00
Average DSCR (M/N)	1.69									

Note: - As the proposed machinery is CNC Machine it is expected that the machine will be fetching good market value even after the project period of 10 Years. Therefore, in this case the Salvage value is expected to be at least net value after providing Depreciation for the project life and this value is considered as the cash flow in the last i.e. 10th year of the project life for simplification. In the alternative case we have to consider the other model where cash flow has to be calculated beyond the project life of 10 Years (perpetuity).

Annexure 5: Details of procurement and implementation plan

S. No.	Activities	Weeks							
		1	2	3	4	5	6	7	8
1	Procurement and Delivery								
2	Civil & Electrical Work								
3	Commissioning								
4	Training								

The Process Down time is weeks 4 and 5; in which first four days would be utilized in removal of older machinery and civil work of rigid base for the new one. The next three days would be there for settling the civil work. Days 8, 9, 10 would be reserved for placing of new machine and it's supportive. And during final four days commissioning, trial run and training for the operators.

Annexure 6: Details of technology/equipment and service providers

Name of Organization	*Communication Address*	*Contact No.*	*E-mail*
PERFECT CNC TECHNOLOGY (P) LTD	K1, AL-RAHMATH APARTMENT, 2-5 CHELLAPPA STREET, OTTERI, CHENNAI- 600 012.	**R.SHA NIJAM BABU** Managing Director Phone: 09382846576, 09840137617	E-mail: perfectcnc10@gmail.com
Ace Micromatic Machine Tools Pvt.Ltd	Plot no.533, 10th main, 4th Phase, Peenya Industrial area, Bangalore-560058	Plot no.533, 10th main, 4th Phase, Peenya Industrial area, Bangalore-560058	-
DMG Mori Seiki India Machines and Services Pvt Ltd	"Parimala Towers" #64 Jalahalli Camp Cross,Off MES Road, Yeshwanthpur IN-560022 Bangalore.	+91 80 40896508	-
Haas Automation	Manav Marketing Pvt Ltd 430-431,12TH cross, 4th Phase, Peenya Industrial Area, Bangalore 560058 India	91-80-4117 9452/53	manav@giasbg01.vsnl.net.in

Annexure 7: Quotations or Techno-commercial bids for new technology/equipment

Specifications

CNC Turret Lathe Machine		120 V – 60 Hz	220 V – 50 Hz
Power Requirement	**Current**	**3 A**	**1.5 A**
Lathe	Swing Over Bed	90 mm (3.5 in)	
	Center Height	101.6 mm (4 in)	
	Distance Between Centers	200 mm (8 in)	
	Swing Over Cross Slide	48 mm (1.9 in)	
	X-Axis Travel	47.8 mm (1.88in)	
	Z-Axis Travel	105.4 mm (4.15in)	
	Resolution	±0.00318 mm (±0.000125 in)	
Headstock	Spindle Bore	10 mm (0.405 in)	
	Spindle Taper	Morse No 1	
Tailstock	Tailstock Taper	Morse No. 0	
	Sleeve Stroke	38.1 mm (1.5 in)	
Main Spindle Drive	**Programmable Speed Range**	0-2800 r/min	
	Motor	160 W (0.21 hp), overload protected	
Feed Motors	Type	Stepper	
	Resolution	400 steps/r	
	Rapid Traverse Speed	356 mm/min (14 in/min)	

Accessories included		
Carbide Insert Tool with Tool Post		35E right-hand insert
Carbide Tool Set with Tool Post	Types	AR4, AL4, BR4, BL4, C4 and E4
Null Modem Serial Cable	Length	3.05 m (10 ft)
	Connectors	DB9 female/female
TTL/IO Cable		
Ethernet Crossover Cable	**Length**	3.05 m (10 ft)
	Connectors	DB15 male/male
Set of Tools Content	**Length**	2.13 m (7 ft)
	Connectors	RJ45 male/male
Fuses	hex keys, cleaning brush, digital caliper and tool bag	
Physical Characteristics	**Current Rating**	1.0 A
	Voltage Rating	250 V
	Dimensions	(HxWxZ) 750x864x597 mm (29.5x34x23.5 in)

PERFECT CNC TECHNOLOGY (P) LTD **PERFECT**

Date : APRIL 13, 2011
Ref No : PA.RS.Y-11:12.Q.012

To
Mr.K.R.SESHADRI
DIRECTOR
SADBHAVA FABRICATOR PVT Ltd.,
No. SB-52, 4th Cross,
1st Stage, Industrial Estate,
PEENYA, BANGALORE – 560 058.
E-Mail: kalkuntekrs@yahoo.com
Phone : 080-28377512,
Fax : 080 – 4117 0890,
Mobile : +91 98440 38525.

Sub : Quotation For Refurbishing Of Your **VERTICAL TURNING LATHE To CNC [Make: IM ROMAN Model: SC17DC, Table Diameter ϕ 1450 mm]**

Ref : Discussions with the undersigned at your works.

Dear Sir,

We thank you very much for the above mentioned enquiry and courtesy extended to the undersigned during his visit to your works. We are pleased to announce ourselves as one of an experience team undertakes both mechanical reconditioning and system interfacing for **FANUC / SIEMENS** systems.

With reference to the discussions the undersigned had with you, kindly find enclosed our **detailed** offer for the above mentioned machine.

We Have Quoted for Reconditioning and Retrofitting of the above said machine and the scope of work **both Mechanical and Electrical** as briefed in the **Annexure**. The New **SIEMENS 802D SL CNC** package provided by us, will be housed in New **RITTAL** or Equivalent quality panel and built with all standard elements like **SIEMENS** switch gears and controls, **OMRAN** Relays and PCBs, **SIEMENS SITOP / OMRON** Regulated Power Supplies, **CONNECTWELL/ PHONEIX** ELMAX and terminating blocks and **LAPP/ FINOLEX** power and control cables etc.,

We hope the above is in line with your requirement. Should you require any further information / clarifications, please feel free to call on the undersigned anytime.

Hoping to receive your valuable order at the earliest and assuring you of our best services always.

Thanking you,
for **PERFECT CNC TECHNOLOGY (P) LTD.,**

R.SHA NIJAM BABU
MANAGING DIRECTOR
encl. : Annexure/ Investment Details/ Terms and conditions.

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ADMIN Office: K1, AL-RAHMATH APARTMENT, 2-5 CHELLAPPA STREET, OTTERI, CHENNAI- 600 012.
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Works: 266, SARASWATHY NAGAR MAIN ROAD, 7th STREET, THIRUMULLAIVOYAL, CHENNAI- 600 062.
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Annexure

MACHINE INSPECTION & DISMANTLING:

We will be deputing our engineers to the machine location and dismantle the same. The following activities will be carried out:

- Detail Inspection of Axes
- Dismantling of the various assemblies of the machine
- Dismantling of the Side Head assembly of the machine and retained at Customer site.
- Listing of all sub-assemblies for dispatching to Retrofitter site at Chennai.
- Organizing the Sub-assemblies in pack worthy form {All Covers, Polythene Bags, Tags, etc. will be provided by you}

FOUNDATION @ CUSTOMER WORKS:

- All Civil works related to Machine Foundation would be to customer's scope
- All foundation pads, grouting material, etc. will be in customer's scope of supply

SPINDLE: (Mechanical Scope)

- Retain Spindle in its existing form as it is.
- If overhauling of the spindle assembly is required such as Dismantling the chuck Inspection of the main bearing and other support bearings.
- Re-checking the oil lubrication points
- Replacing the oil seals and 'O' rings.
- Checking all the gears for its re-usability and in case, any replacement is required then new gears will be arranged to supply and replace for the damaged one.
- Automatic gear changing problems will be studied and whatever the required correction needed will be executed and ensure the trouble free gear changing.
- Heavy Oil Leakage problem will be studied and necessary measures and corrective action will be carried out to arrest the complete oil Leakage.
- In the above case all the spares need to replace will be accounted to 'Customer scope'

JOB CLAMPING OF CHUCK:

- The Existing Chuck job clamping arrangements will be checked for its smooth functionalities. If there is any problems will be identified the same will be rectified by dismantling the clamping assembly.
- The oil seals, cylinders related to the clamping mechanism will be overhauled and the seals and 'O' rings will be replaced to avoid the oil leakages and pressure dropping.
- The clamping jaws will be reworked and the clamping fasteners will be replaced by the new one.

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CROSS MOVEMENT OF LH –SIDE SLIDE (X1 - AXIS):

- Alignment and Leveling of the guide ways.
- Cleanup of the entire X1-Axis assembly
- Change of existing lead screw to **New Ball screw** of adequate capacity. Related mechanical modifications to fit the ball screw to be carried out(ϕ **50mm** Ball screw with Double Nut)
- X1-Axis gear box will be removed and mechanical modifications for fitment of **new AC Servo Motor** with Timer Belt and Pulley arrangement will be done.
- Complete Scrapping of X1 SLIDE will be done. On the X1 Slide bottom, new **Anti Friction Material** will be pasted and scrapped to match with the cross rail.
- Any machining if required will be carried out.
- Overhaul the complete sub-assemblies, seals, bearings of the axis
- We will be providing better cable looping with necessary metallic ducts, which will be able accommodate the additional cables.
- New Wipers for Axis will be fitted to protect the Guide ways.
- The Existing Telescopic cover will be serviced and used and if the new Telescopic covers is required to replace the old one, will be arranged to protect the X1-axis slides and guide ways (Option)
- After machine complete assembly, power on and successful geometrical test results, we will be calibrating the X1-Axis by LASER calibration and compensating the errors to at most possible minimal level at Customer Site.

RAM TOOL SLIDE UP / DOWN ON LH-SIDE (Z1-AXIS):

- Check condition of existing guide ways.
- Cleanup of the entire Z1-Axis assembly
- Change of existing lead screw to **New Ball screw** of adequate capacity. Related mechanical modifications to fit the ball screw to be carried out (ϕ **50mm** Ball screw with Double Nut)
- Z1-Axis gear box will be removed and mechanical modifications for fitment of **new AC Servo Motor** with Timer Belt and Pulley arrangement will be done.
- Complete Scrapping of Z1 saddle will be done. On the Z1 Slide bottom, new **Anti Friction Material** will be pasted and scrapped to match with the Z1 Bed.
- Any machining if required will be carried out.
- Overhaul the complete sub-assemblies, seals, bearings of the axis.
- We will be providing better cable looping with necessary metallic ducts, which will be able accommodate the additional cables.
- New Wipers for Axis will be fitted to protect the Guide ways.
- The Existing Telescopic cover will be serviced and used and if the new Telescopic covers is required to replace the old one, will be arranged to protect the Z1-axis slides and guide ways (Option)
- After machine complete assembly, power on and successful geometrical test results, we will be calibrating the Z1-Axis by LASER calibration and compensating the errors to at most possible minimal level at Customer Site.

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CROSS MOVEMENT OF RH –SIDE SLIDE (X2 - AXIS):

- Alignment and Leveling of the guide ways.
- Cleanup of the entire X2-Axis assembly
- Inspection of existing lead screw for the re-usability and if any correction is required will be carried out such as re-turning the lead screw pitches and based on the correction the New Box Nut will be Replaced.
- X2-Axis gear box will be over hauled and entire mechanical arrangement for Rapid and feed movement will be serviced and retained.
- Complete Scrapping of X2 Bed will be done. On the X2 Slide bottom, new **Anti Friction Material** will be pasted and scrapped to match with the cross rail.
- Any machining if required will be carried out.
- Overhaul the complete sub-assemblies, seals, bearings of the axis
- We will be providing better cable looping with necessary metallic ducts, which will be able accommodate the additional cables.
- New Wipers for Axis will be fitted to protect the Guide ways.
- The Existing Telescopic cover will be serviced and used and if the new Telescopic covers is required to replace the old one, will be arranged to protect the X2-axis slides and guide ways (Option)
- After machine complete assembly, power on and successful geometrical test results will be carried out.

RAM TOOL SLIDE UP / DOWN ON RH-SIDE (Z2-AXIS):

- Check condition of existing guide ways.
- Cleanup of the entire Z2-Axis assembly
- Inspection of existing lead screw for the re-usability and if any correction is required will be carried out such as re-turning the lead screw pitches and based on the correction the New Box Nut will be Replaced.
- Z2-Axis gear box will be over hauled and entire mechanical arrangement for Rapid and feed movement will be serviced and retained.
- Complete Scrapping of Z2 saddle will be done. On the Z2 Slide bottom, new **Anti Friction Material** will be pasted and scrapped to match with the Z2 Bed.
- Any machining if required will be carried out.
- Overhaul the complete sub-assemblies, seals, bearings of the axis.
- We will be providing better cable looping with necessary metallic ducts, which will be able accommodate the additional cables.
- New Wipers for Axis will be fitted to protect the Guide ways.
- The Existing Telescopic cover will be serviced and used and if the new Telescopic covers is required to replace the old one, will be arranged to protect the Z2-axis slides and guide ways (Option)
- After machine complete assembly, power on and successful geometrical test results, we will be calibrating the Z2-Axis by LASER calibration and compensating the errors to at most possible minimal level.

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CROSS RAIL UP / DOWN MOVEMENT:

- The Cross beam will be dismantled, aligned and Scrapped fully will be check Complete contact with X1 & X2 SLIDES will be done by us and ensuring more than 85% of blue seating through out the entire length of Cross rail.

COLUMN:

- Column will be retained as it is and the alignment will be check and the corrective measures will be carried out on the same if required. Both the CROSS BEAM and RAM will be dismantled from the column and taken out for reconditioning.

MANUALTURRET INDEXER:

- The complete Manual Tool Turret will be retained as it is and overhauled by dismantling the same and cleaned up. If any spares required to replace will be carried out for trouble free functionality.

HYDRAULIC POWER PACK:

- The complete hydraulic power pack will be retained as it is and overhauled by dismantling the same and cleaned up.
- The New hydraulic hoses and valves of YUKEN / REXROTH will be provided and all machine related functions will be taken care.
- The hydraulic filter problem will be eliminated by replacing the same by a new one and adequate preventive measures will be carried out to avoid the same problem frequently in feature.
- The hydraulic oil leakage problems will be observed and the oil seals and 'O' rings will be replaced by the new one.

CENTRALIZED LUBRICATION SYSTEM:

- A complete new Centralized Lubrication System (CEN LUB) along with the piping and cartridges will be provided for the axes guide ways, ball screws and nut housing.
- All mechanical modifications/ piping for the lubrication system will be done.

GEOMETRICAL CHECK:

- Geometrical Accuracy Check according to VTL / Original Machine Test Chart
- Laser Calibration of Axes can also be done at our works after the geometrical test is completed.
- Any other scope of work which has not been mentioned above and is called for during the course of the retro fitment of the machine will be done at an extra cost. Same can be decided mutually between both the parties.

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Electrical Scope Of Supply

- The present Electrical will be replaced with a new CNC i.e. **SIEMENS 802D sl CNC** System on LHS of the Machine and RHS of the RAM will be interfaced with SIEMENS switch Gears and the same will be controlled by PLC Logic.
- The new CNC system and drive's will be housed in a New Control Cabinet (IP54/55) and wired fully with all new switchgears, Lapp / Finolex cables in accordance with our wiring standards. We will also incorporate Relay Boards and TSC's in the panel. Provision for Tube light / Incandescent Lamp and 3 - pin socket (220 V AC) will be made in the control panel. **The control cabinet will be mounted on the floor behind the machine.**
- We shall be interfacing **New AC Servo motors** on **LHS axes** i.e. **X1 & Z1** of adequate capacity and the same will be wired to the new CNC Control.
- We shall be **retaining the Old AC induction motors on RHS axes** i.e. **X2 & Z2** and the same will be wired to the new CNC Control.
- The **new servo spindle motor of SIEMENS of 60KW power rating** of FOOT mounted type and the adequate capacity of the drive will be wired up and interfaced to the new control panel. All the necessary bracket and fitments required for the same will be done by us.
- Interfacing / Replacement for other related hardware, feedback and power cables, for above, wherever required.
- Machine wiring will consists **wiring** of AC Servo motors, Encoders, Limit switches, Scales/ Encoders (If Any), Lubrication system, Coolant system, Machine lamp, Safety switches, etc. wherever applicable.
- The wiring on the machine side will be changed in totality and the same will be routed to the panel in a proper manner with conduits/ hoses etc.
- Junction boxes will be provided for termination of cables with Phoenix/ Elmax terminal station.
- A new operating pendant box will be provided which will house the CNC CRT screen and Operator keyboard. This will be mounted on the existing hanging pendant area.
- Interfacing works of all the above mentioned items and complete programming and trials to your satisfaction.
- All the existing functions of the machine will be incorporated and software development debugging and prove out will be done.
- We shall be trying out any one type of your jobs. You will have to provide us the drawing of the same. Also all the tooling, fixtures, etc. required for the job to be proved would have to be arranged by 'END USER'.
- We shall be providing Application / Maintenance Training to your personnel on your machine.

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MACHINE ASSEMBLY ACTIVITIES AFTER RE-CONDITIONING

- After readiness of all individual sub-assemblies such as X-axes Slides and Z-axes Rams will be assembled with all new FASTNERS with proper alignment and leveling as stage by stage.
- Final complete assembly of the machine will be done and all the sub assemblies will be erected stage by stage, and ensured with proper leveling and alignment.
- Once the final assembly of the machine comes to some progressive stage, The main control panel will be interfaced with machine and its control, driving and feed back elements will be wired up with proper cable track chains, conduits, Metallic ducts and junction boxes.
- After ensuring the completion of the mechanical and electrical wiring activities are over the machine power on will be carried out and as per our systematic way of commissioning will be carried out.
- All existing machine functions will be re-ensured with the CNC controller and sufficient amount of the trials will be carried out.
- Geometrical Test as per the standard test chart / machine suppliers test chart will be carried out and the readings will be recorded by the machine re-conditioner and the customer. If there is any deviation will be observe, the same will be corrected immediately with in best possible limits.
- Once the machine commissioning will be over in all aspects such as machine functions checking with proper safety interlocks, Alarms and Messages information for quick and easy maintenance facilities.
- Dry run test of the machine will be performed for a period of 24 Hours non stop with all machine functions and programming features.
- After the dry run test, the machine will loaded with some test piece to perform the cutting load test, and execute the NASA test program to ensure accuracy level of the machine. If there is any deviation is noticed, then the same will be corrected by maximum possible close tolerance level of the machine and ensured.
- Laser Calibration of Axes can also be done at your works after the geometrical test is completed.
- After the laser calibration is completed the machine will be handed over to the customer for regular production.
- The machine will be re-conditioned and retrofitted at customers work site. Hence the customer is requested to arrange the sufficient facilities such as arrangement of sufficient space to keep and execute the re-conditioning activities, and arrangement of EOT, mobile Cranes, fork lift as well as hydraulic jacks.
- If the above case is not possible the machine has to be sent to work site, and an additional cost for the transportation of the machine (To & Fro) will be accounted to customers account.

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Investment Details

Price for Retrofitting and Reconditioning of Your **VERTICAL TURNING LATHE To CNC [Make: IM ROMAN Model: SC17DC, Table Diameter ϕ 1450 mm]** Consisting of The Following:

1.1] **SIEMENS 802D SL PRO** Version CNC Package Consists of:

1. **SIEMENS 802D sl** CNC System
2. AC Servo Motors for **X1 & Z1 axes** of **27Nm & 27*Nm and all with ABSOLUTE type Encoder**
3. AC Digital Drives for above motors.
4. AC Spindle Motor of **60 KW** and AC Digital Drive
5. Mini HHU Manual Pulse Generator.
6. 10.4" Color LCD [OP 10]
7. Machine Control Panel
8. NC Key board
9. Power, Feedback Cables
10. All mating connectors.
11. USB PEN Drive memory connectivity
12. System Manuals (Soft Copy {CD} - 1 Set)

* Denotes servo motor with brake

CNC System Configuration:

802D sl PRO + 27 Nm / 3000 rpm x 1 (1FK7 series) + 27 Nm / 3000 with brake x 1 (1FK7 series) + 60 KW Spl motor with rated RPM : 1250 , SH : 180 + NC key board + 10.4" color TFT monitor +MCP + 1024 / 2500 PPR encoder for spindle with 20 meters cable + 2 PP modules + 20 meters power and ABSOLUTE FB cable x 2 Nos. each + Spindle motor power and feed back cable of 10 mtrs length + MCPA Interface module + 20A, 24V DC regulated power supply x 2 Nos. + USB Pen drive connectivity

1.2] Electrical Interface Hardware Consists Of:

1. Cables as required.
2. Conduits as required.
3. New Wired Up Panel (IP 54/55) Materials Include:
   a. Relay Logic PCB & Terminal Strip Converters
   b. Power supply unit [24V DC]
   c. Related switchgear and accessories, wherever required.
   d. Control Transformer
4. Limit Switches for Axes (X1, X2, Z1 & Z2 Axes)
5. Retrofit Manuals (Hard Copy - 3 Sets) consisting of:
   a. Ladder Diagram, Cross Reference, Alarms & Messages
   b. Electrical Circuit, Spares Listing, Operators Board Reference
6. Spindle Encoder {1024 PPR / 2500 PPR}
7. Panel cooler (4000 BTU)
8. 24V, 20A DC regulated power supplies

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1.3] Mechanical Interface Hardware To Suit CNC System Consists Of:

1. Supply of mechanical components related to package fitment consisting of:
   - Motor Mounting Brackets, Pulleys, Couplings for all axes
2. Operator Pendant Box
3. Ball screws For X1 & Z1 Axes of ϕ **50mm x 10mm pitch** with double nut.
4. End Bearings, Nut Housing, Brackets, Pulleys for above ball screws.
5. Centralized Lubrication System + Piping for Axes
6. Turcite Material for all matching Surfaces
7. Dogs, Rails For Above Limit Switches
8. Cable Drag Chain For the X1, X2, Z1 & Z2 Axes.

TOTAL [For Items 1.1 - 1.3] 1 SET **Rs. 26,32,825.00**

1.4] Scope Of Work Involved For The Subject Machine As Follows:

1. Complete Scope of Work as per the enclosed annexure {Electrical + Mechanical}
2. Charges for SCRAPPING
3. All axes ball screws mounting, alignment.
4. Ladder logic development for the various functions of the machine.
5. JOB trials and operator and maintenance training.
6. One year free warranty service if there is any Electrical & Mechanical related problems.

TOTAL [For Item 1.4] 1 SET **Rs. 5,57,665.82**

OPTION's:

S. NO	DESCRIPTION	QUANTITY	PRICE
1.	Machine Painting	1 SET	**Rs. 45,000=00**
2.	Telescopic cover for All the AXES	1 SET	**Rs. 2,25,000=00**
3.	Laser Calibration Charges {If to Be Done At Customer's Works}	1 SET	**Rs. 30,000 =00**

ITEMS NOT COVERED IN OUR STANDARD SUPPLY SCOPE:

- Chip Conveyor
- Machine Guards
- Machine Foundation Pads/ Bolts

For other details refer Terms and conditions.

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Terms and Conditions

PRICES : Quoted prices are ex-works, Chennai and exclusive of packing and forwarding. Above prices are for the scope of supply as mentioned above and charges for interfacing the system package.

TERMS OF PAYMENT:
Payment has to be made in the form Local Chennai cheque or through Demand draft only.

For Material Bill: (Item 1.1 to 1.3)
50% advance along with the order, 50% + Taxes against Proforma Invoice during materials supply. **MODVAT** Benefit will be passed on to the Customer

For Service Bill: (Item 1.4)
30% advance along with purchase order, 60% + Taxes against dry run test of the machine, 10% after final minutes of meeting.

TAXES : [For Items 1.1 - 1.4]: Quoted price are exclusive of Excise duty, Sales Tax/ VAT, any further duties and levies. Same will be charged extra as applicable at the rate prevailing at the time of delivery.

DELIVERY : Delivery of materials will be within **10 weeks** ex - works from the date of your confirmed, technically and commercially fully clarified order with necessary advance. Re-furbishment and commissioning of interfacing of the machine at our works will be within **30 Working Days** after receipt of machine and other materials.

WARRANTY : service warranty is for a period of **Twelve months** from the date of commissioning and System warranty for a period of **TWENTY FOUR months** from the date of dispatch of the materials, whichever is earlier against faulty workmanship and defective materials. However, consumables and parts subject to normal wear and tear are excluded from such warranty.

PACKING & FORWARDING	:	Extra @ 2% of total order value.
TRANSPORT	:	Extra @ 3.5% of total order value.
INSURANCE	:	To Be Taken Care Of By Customer.

VALIDITY : This quotation is valid up to 30 days from the date of this offer. Validity beyond this period is subject to confirmation from us. However, this offer to you subject to our further acceptance at the time of your firm order.

FORCE MAJEURE : Terms and conditions governing this contract, specially the delivery, are subject to force majeure clause.

OTHERS :
1. All necessary Documents related to the machine have to be handed over to us.
2. You will have to provide us the material handling facilities at your site.
3. Executive Canteen, Local Conveyance Facilities will have to be provided to our staff at your works during the commissioning of the machine.
4. All axes accuracy's are depending on the Machine Mechanical condition.
5. Voltage Stabilizer is suggested for better reliability of CNC package.
6. Machine will be reconditioned and retrofitted @ Chennai works

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PURCHASE ORDER:
Formal purchase order has to be placed on:

Works :

PERFECT CNC TECHNOLOGY (P) LTD.,
266, SARASWATHY NAGAR,
7Th Main Road,
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AVADI,
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for **PERFECT CNC TECHNOLOGY (P) LTD.,**

R.SHA NIJAM BABU
MANAGING DIRECTOR

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