DETAILED PROJECT REPORT
ON
REPLACEMENT OF MILLING, TURNING MACHINES TO CNC TURN –MILL CENTRE
(BANGALORE MACHINE TOOL CLUSTER)











ENERGY IS LIFE
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Bureau of Energy Efficiency

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REPLACEMENT OF CNC MILLING CENTRE & CNC TURNING CENTRE BY A CNC TURN MILL CENTRE

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

Detailed Project Report on Replacement of turning center & milling center to a CNC Turnmill Center

Bangalore Machine Tool cluster, Karnataka (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.:

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We take this opportunity to express our appreciation for the excellent support provided by Machine Tool Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the cluster manual.

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Petroleum Conservation Research Association

Bangalore

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List of Abbreviations

BEE	Bureau of Energy Efficiency
CNC	Computer Numerical Controlled
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EA	Energy Audit
EE	Energy Efficiency
GHG	Green House Gas
GoI	Government Of India
INR	Indian National Rupee
IRR	Internal Rate Of Return
kWh	kilo Watt Hour
NPV	Net Present Values
O&M	Operational & Maintenance
PAT	Profit After Tax
PBT	Profit Before Tax
ROI	Return on Investment
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.

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 recommendations made in the cluster manual is listed below:

Replacement of CNC milling, turning machines with CNC Turn –mill centre or new CNC Turn-mill centre. The convincing features of the CNC Turn mill in terms of performance, flexibility and easy setup can be summarized as follows:

- ✓ Reduced cycle times due to a simultaneous, independent machining with up to four tool carriers
- ✓ Free allocation of the tool carriers to the two spindles.
- ✓ Simultaneous operation of up to three tools on the main spindle.
- ✓ Modular system for configuring the machine according to parts-specific requirements
- ✓ Large-sized tool change area minimizes the risk of collision
- ✓ Large tool stock (containing up to 80 tools) when twin tool holders and Y axis are used

This results in significant saving in production cost and noticeable increase in productivity. This has a great impact on job work cost and so we are able to do job work with excellent quality at affordable cost. The CNC Turn mill center gives high productivity in an economical way. It has the ability to produce variety of components without re-tooling and thereby saving in production cost. It is best suitable for regular and repetitive job work. And under proper maintenance will serve the owner for a period of 12 to 16 years.

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)	50.48
2.	Electricity saving	kWh	87687.6
3.	Monetary benefit	` (in lakh)	17.62
4.	Simple payback period	years	2.86
5.	NPV	` (in lakh)	32.90
6.	IRR	%age	22.90
7.	ROI	%age	21.12
8.	DSCR	ratio	1.69
9.	CO_2 reduction	Tonnes/annum	65.8
10.	Procurement and implementation schedule	week	9

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 cluster 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.

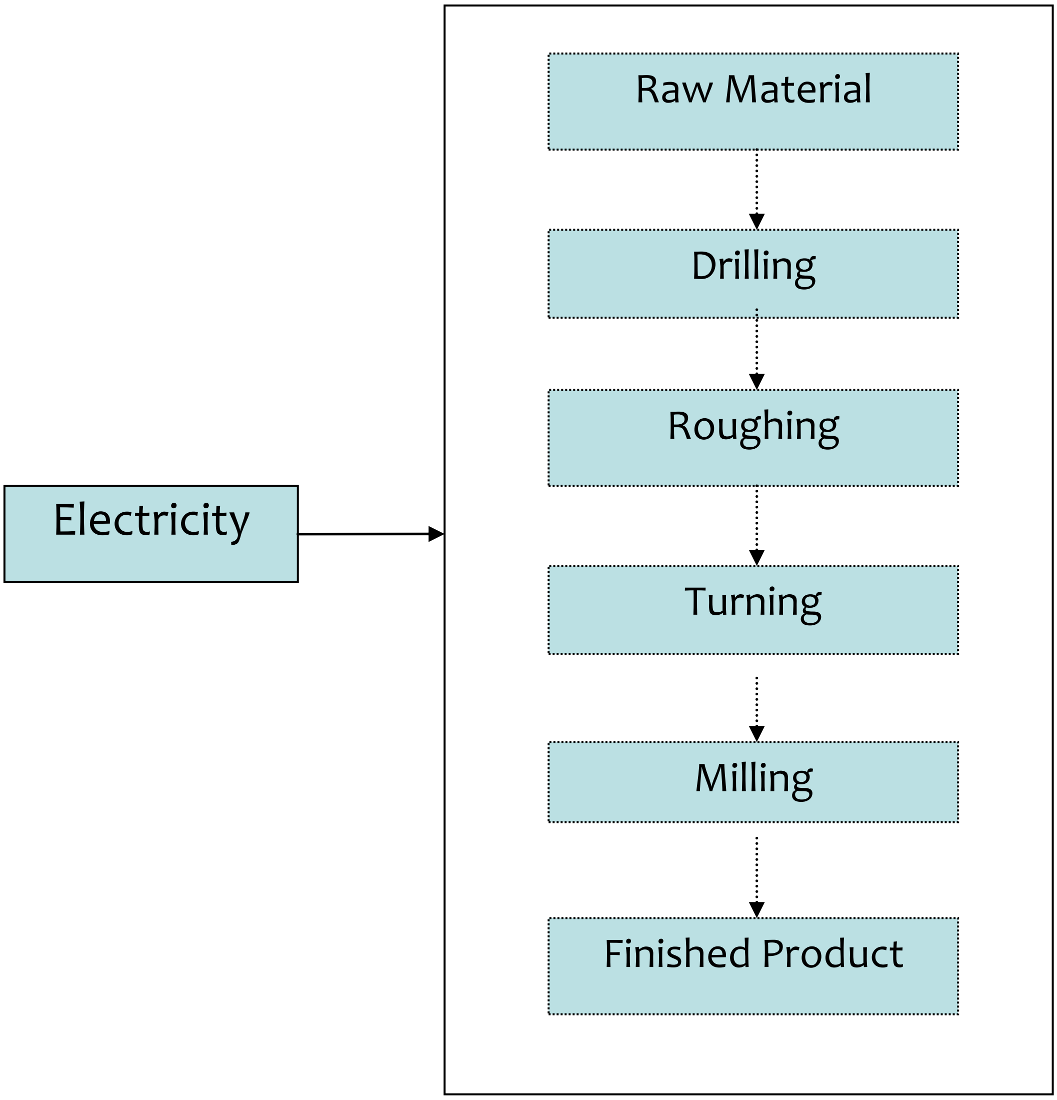
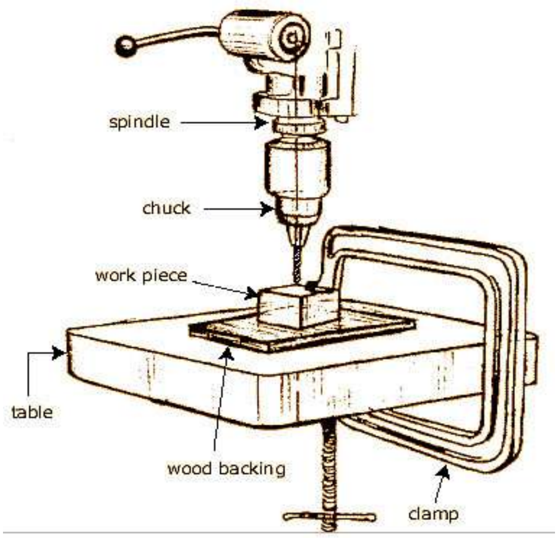


Figure 1.1 Process flow chart of typical Machine Tools Unit

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.

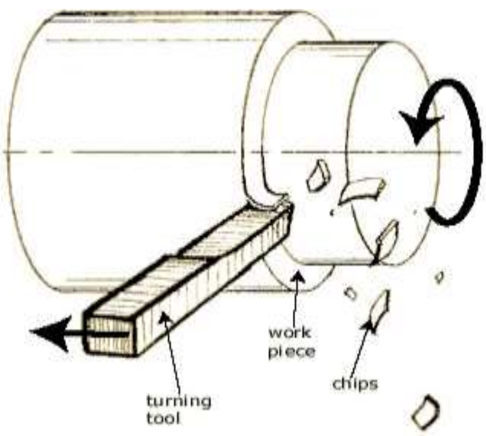
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

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.

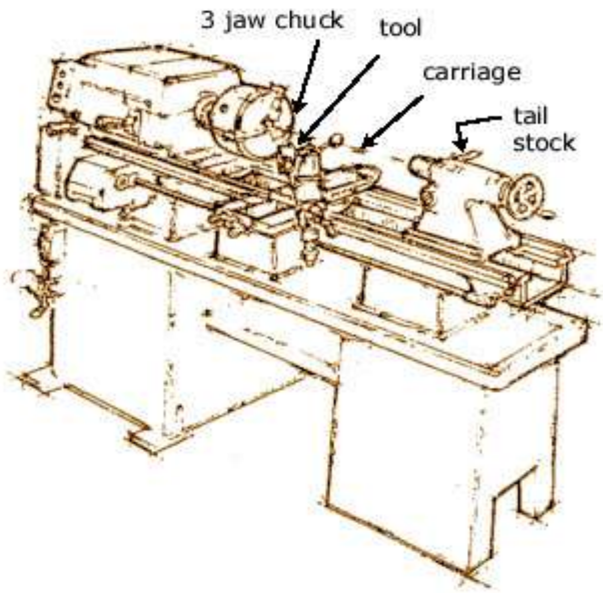
When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

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 Axis 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 favorably 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:

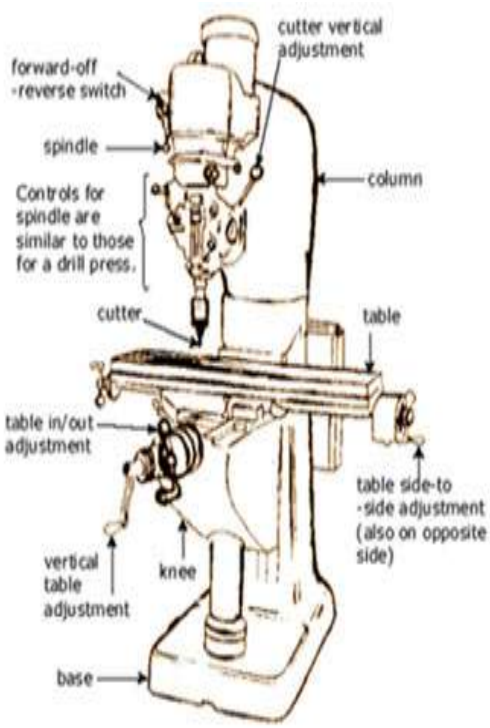
- ***Boring***

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, a limited application. But one that is available to the skilled turner/machinist. 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. Lineboring (line boring, line-boring) implies the former. Backboring (back boring, backboring) 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***

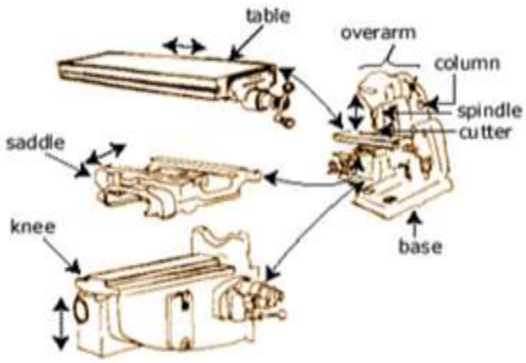
The cutting of a serrated pattern onto the surface of a part to use as a hand grip using a special purpose knurling tool. Threading both standard and non-standard screw threads can be turned on a lathe using an appropriate cutting tool. (Usually having a 60, or 55° nose angle) Either externally, or within 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.

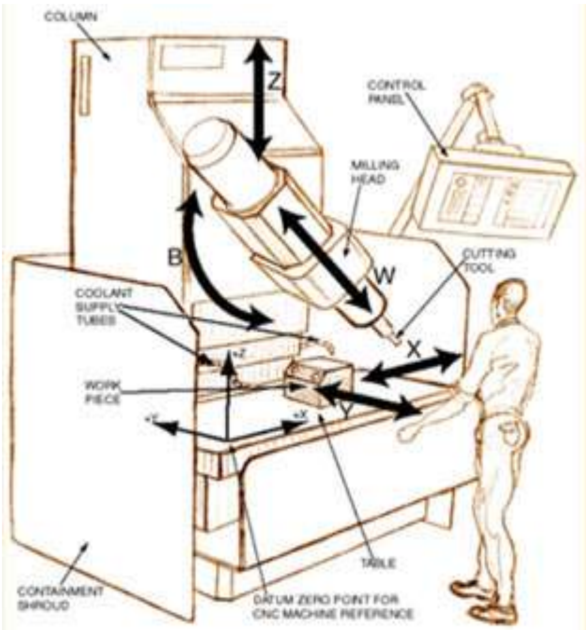
Milling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three-dimensional surface contours. Parts that are fabricated completely through milling often include components that are used in limited quantities, perhaps for 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 Axis that they possess. Axis 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 Axis: 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.

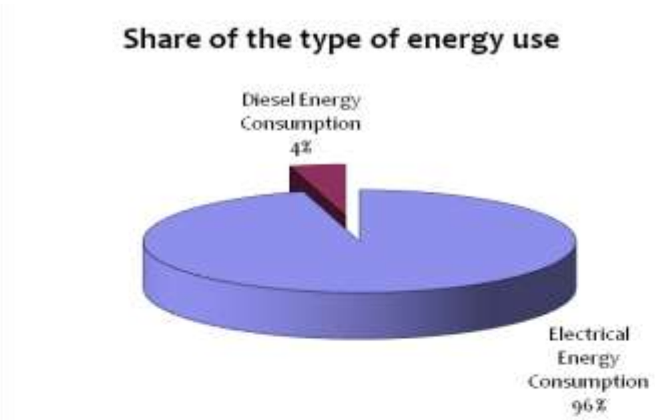


Figure 1.2: Share of Energy Type used in the Machine Tool Units

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 CNC Turning center and CNC Milling center for performing jobs in either combinations or separately single devices whereas some other 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 CNC Turning center & then to CNC Milling center machines 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.

Table 1.2 Specific energy consumption of machine tool cluster

S.No.	Particulars	Case1	Case2	Case3

1	Annual Electricity Consumption, kWh	141,024	147,132	73,944
2	Annual Fuel (HSD) consumption, Lt	500	3000	800
3	Annual Energy Consumption, GJ	525.6	636.5	294.7
4	Average Specific Energy Consumption, GJ/T	21.9	6.6	15.85
5	Total Annual production, Tones	24	96	18.6
6	Reduction in Rejection rate out of replacement by CNC machine/savings in amount(Rs.)	0.045/13500	0/0	0/0
7	Labour saving per month/ Annual savings due to labour charges (Rs./Rs.)	2000/24000	6000/72000	6000/72000

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.

The NC machines developed in the 1950s and 1960s did not possess CPU's. The CNC machine tools are essentially NC machines with microprocessors as the CPU.

The first American machine tools with a CNC system was developed in 1972 and the first Japanese machine tools with a CNC system was developed in 1976. CNC systems made it possible for microprocessors and programmable logic controllers to work in parallel. This allowed simultaneous servo position and velocity control of several Axis of a machine, monitoring of the controller and machine tools performance, and monitoring of the cutting process. For a basic three Axis milling machine, with the CNC systems, there could be coordination of feeding velocity and position control of all the three Axis. The spindle speed could also be controlled simultaneously. These features enhanced the versatility of a traditional milling machine. Moreover, by employing multiple CPU's, the versatility of the machine tools was increased manifold.

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 up to 10000 rpm, traverse rates of up to 60 mpm are produced by the Indian industry.

The current trend in machining centers is to have additional Axis 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 Axis. 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

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 work piece 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.

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 cluster units out of which 21 were preliminary audits and 9 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 Rs. 121704 per tonne.

Table 1.3 Energy Consumption Pattern of Machine Tools Cluster

.Particulars	Unit	Case – 1	Case - 2	Case - 3	Average
Specific Energy Consumption	kWh/Tonne	5879	1533	3976	3796
Average Energy Cost	`/Tonne	29395	7665	19880	18980
Cost of Material Rejection	`,/tonne	12500	4167	21505	12724
Other Cost (Man Power/Utility)	`./tonne	90000	90000	90000	90000
Average Production	***`/tonne***	***131895***	***101832***	***131385***	***121704***
Annual Production	Tonne	24	96	18.6	46.2
Annual Production Cost	`	3165480	9775872	2443761	5622725

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.

S. No.	Type of Fuel	Unit	Value	Equivalent Energy (GJ)	%age Contribution
1	Electricity	kWh/year	73,944	266.2	90.3

*****Based on measured actual electricity consumption by the existing technology (18.6 tonnes produced annually)***

S. No.	Type of Fuel	Unit	Value	Equivalent Energy (GJ)	%age Contribution
1	Electricity	kWh/year	1,41,024	507.8	96.6

*****Based on measured actual electricity consumption by the existing technology (24 tonnes produced annually)***

S. No.	Type of Fuel	Unit	Value	Equivalent Energy (GJ)	%age Contribution
1	Electricity	kWh/year	1,41,024	507.8	96.6

*****Based on measured actual electricity consumption by the existing technology (96 tonnes produced annually)***

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:

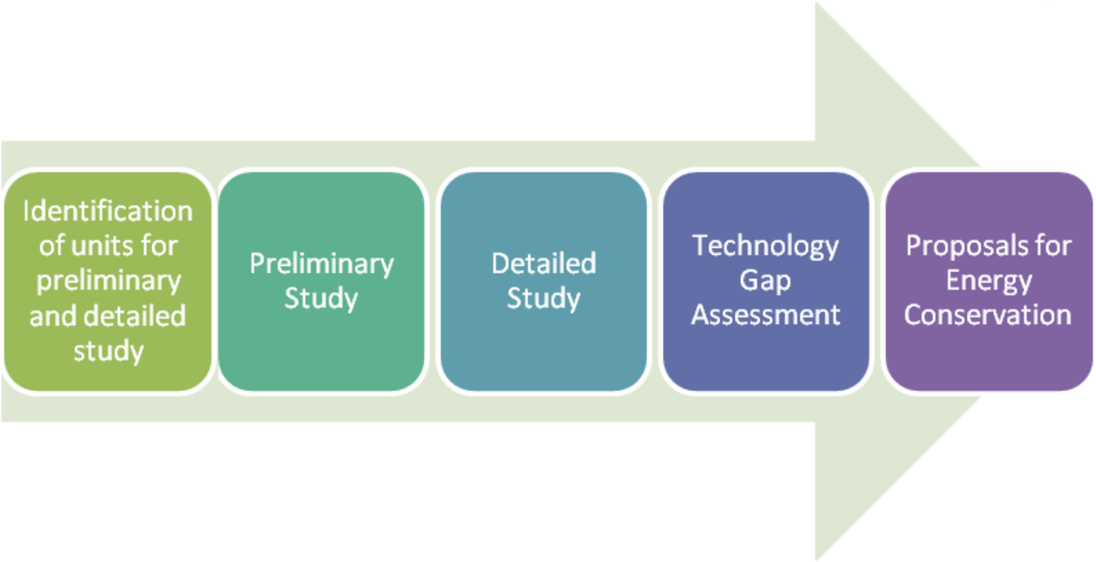


Figure 1.3 Energy auditing methodology

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 21 machine tool 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

Based on the data collected from 21 units where the energy audits were conducted, the average specific energy consumption in a typical machine tool is being calculated to be 2, 26, 79,100 of BESCOM electricity & 99,376 of Diesel to Produce capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum. 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.

Turn/Mill Machines are machines that are capable of both rotating-workpiece operations (turning) and rotating-tool operations (namely milling and drilling). Generally these machines are based on lathes. The machine is typically recognizable as a horizontal or vertical lathe, with spindles for milling and drilling simply available at some or all of the tool positions. With a machine such as this, a part requiring a variety of operations can be machined in one setup, particularly if a subspindle allows the part to be passed from one spindle to another during machining. More recently introduced turn/mill machines depart from the lathe design into something much more like a hybrid machine—combining a lathe's chucks and spindles with the travels and milling power of a machining center. One of the most significant issues with these types of machines in general is figuring out just which parts to run on them. Many shops have discovered that, even though these machines developed from lathes, they are not necessarily limited to round parts. Various non-round parts can be machined on the same platform as efficiently, if not more efficiently, than on a machining center.

The turn-mill center has identical main and counter spindles, and the tool mountings with a diameter of 30 mm comply with DIN 69880 and allow an exact and rapid positioning of the tool holders. The tool carriers are traversable in X and Z direction and optionally in Y direction. They allow simultaneous high-productive cutting with four Y Axis at main and counter spindle in combination with the tool drives. Putting a step ahead in turning centre technology building a world class machine having a dynamic performance giving marvelous results even in Hard Part Machining and designed is 45° Slant bed structure for superior rigidity and durability providing value for money. Setting up a standard in terms of power, torque, precision and accuracy these series of machine are fully capable to work with higher load carrying capacity and entertain complex jobs with cost effective solutions with better tool life.

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. CNC opposed spindle turn/mill center offers the ultimate in machining design and CNC capability for milling and turning of complex parts in ONE SETUP. Features include:

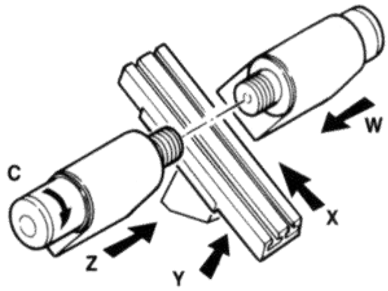
- Full enclosure, stand alone control, coolant, pneumatic drawbar all standard equipment
- GE Fanuc or Fagor CNC
- Graphite milling
- Tracing - Digitizing
- High speed spindles to 60,000RPM
- 4 linear and 2 spindle Axis
- 4 axis simultaneous interpolation of live milling tools
- Part transfer from spindle to spindle for cot-off and end finishing
- 1"bar capacity, may be bar fed from either side

Table 2.1 Equipment Speciation

MECHANICAL SPECIFICATIONS			
ITEM		FTC-180MC	FTC-280MC
Spindle bore	mm	56	62
Spindle front bearing diameter	mm	90	100
No. of tools	-	12	12
Turning tool size	mm	20	25
Boring tool size	mm	25	40
Tool change time	sec	0.18	0.24
Live tooling spindle speed	RPM	6000	4000
Rapid traverse	mm/min	X: 24 Z: 24	X: 12 Z: 18
Cutting feed	mm/min	10,000	10,000
Quill diameter	mm	65	100
Quill taper	-	MT4	MT4
Quill travel	mm	90	100
Spindle power	(Kw) HP	(7.5) 10	(15) 20
Live tooling turret spindle power	(Kw) HP	(3.7) 5	(3.7) 5
Coolant tank capacity	l	100	95
Machine Weight	Kg	3550	5050
Floor Space	cm	293 x 172	279 x 190
Swing over bed	mm	560	600
Swing over saddle	mm	270	300
Max. turning diameter	mm	210	280

Max. turning length	mm	340	570
X axis travel	mm	190	232
Z axis travel	mm	360	600
C axis travel	Deg.	360	360
Spindle speed	RPM	4500	4500
Spindle Nose	-	A2-5	A2-6

2.1.3 Suitability or integration with existing process



The turn-mill center is designed as a modular system equipped with two, three or four tool turrets. Thus, machining with as many as 80 fixed or driven tools is possible without a magazine. The machine processes geometrically complex series parts with a diameter of as much as 65 mm and a length of as much as 300 mm. 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.

2.1.4 Superiority over existing technology

Turn/Mill Machines are machines that are capable of both rotating-workpiece operations (turning) and rotating-tool operations (namely milling and drilling). Generally these machines are based on lathes. The machine is typically recognizable as a horizontal or vertical lathe, with spindles for milling and drilling simply available at some or all of the tool positions. With a machine such as this, a part requiring a variety of operations can be machined in one setup, particularly if a subspindle allows the part to be passed from one spindle to another during machining. More recently introduced turn/mill machines depart from the lathe design into something much more like a hybrid machine—combining a lathe's chucks and spindles with the travels and milling power of a machining center. One of the most significant issues with these types of machines in general is figuring out just which parts to run on them. Many shops have discovered that, even though these machines developed from lathes, they are not necessarily limited to round parts. Various non-round parts can be machined on the same platform as efficiently, if not more efficiently, than on a machining center.

- A multitasking (turnmill) machine that can mill a work piece top and bottom at the same time has advantages for long, slender work piece such as turbine blades, propellers and aerospace structural components

- The B658 and B1200 turn-mill machines boast 35-hp integral spindle with 3.66" bar capacity (with 4.02" optional), double wound motor, 26" (B658) and 48"(B1200) turning length and dual spindle.
- These turn-mill centers deliver glass scales in X, Y, and C axis as well as air-conditioned electronics and a programmable automatic tool probe system.
- With features such as 96 cutting tools or 24 live tools, extremely complex parts can be machined in one operation or hundreds of different parts with one setup, the company says.
- It offers advanced technical features such as damage protection software, tool load monitoring, tool life management, rigid tapping and polygonal turning.

2.1.5 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.

2.1.6 Source of technology

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

2.1.7 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. Emtex Marketing Pvt.Ltd. And Mazak company is the service provider for this technology. They have the experience in supplying the CNC Turnmill machine and provided consultancy & implementation support. The detailed contact information of all service providers is provided in annexure - .

2.1.8 Terms and condition of sales

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

2.1.9 Process down time during implementation

The installation of Turnmill machine center can be done in the 5-7 days, However the Turnmill machinecenter is end to end solution of turning & milling Process 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 Turnmill machine center, the technology and machine will continue to work up to 15 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

Turnmill machine center is suitable for the units involved in the production of bulk quantity and largecross section job/product.

3 ECONOMIC BENEFITS FROM NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel saving

At present majority of the machine tools manufacturing units operate with conventional/CNC turning & milling machine in steps. Existing technology required two or three timeset up of the job on the plate result in increase in time, energy and rejection. The existing technology also required a skilled manpower to operate this type of production machinery.

Installation of Turnmill center 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 Turnmill center 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 Turnmill center Machine are tabulated below:

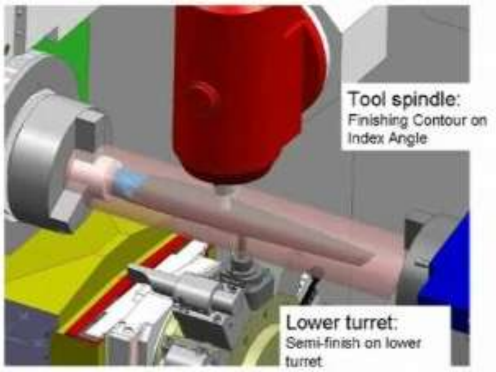
Table 3.1 Energy savings per year

S.No	Particular	Unit	Conventional machine	CNC Turn-Mill
1	Specific Energy Consumption	kWh/Tonne	3796	2847
2	Average Energy Cost	`/Tonne	18980	14235
3	Cost of Material Rejection	`,/Tonne	12724	2544.8
4	Other Cost (Man Power/Utility)	`./tonne	90000	85850
5	***Average Production***	***`/tonne***	***121704***	***102629.8***
6	Annual Production	Tonne/annum	46.2	46.2
7	Annual Production Cost	`/annum	5622725	4741496.8
8	Reduction in Production Cost	`/Tonne	19074.2	
9	Annual Production Rate	Tonne/annum	46.2	
10	Annual cost reduction	`/annum	881228.04	

3.1.2 Improvement in product quality

Turn mill 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 Turn mill 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.

3.1.3 Increase in production



A Turn mill 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 turnmill machines revels that the turn mill machine may produce two times production/ material at same time and at same energy consumption. A multitasking (turnmill) machine that can mill a work piece top and bottom at the same time has advantages for long, slender work piece such as turbine blades, propellers and aerospace structural components.

3.1.4 Reduction in raw material consumption

The rejection of material in turn mill CNC machining is almost nill while comparing with existing system/technology. However, in the cost calculation about 20% of the existing rate of rejection is considered.

3.1.5 Reduction in other losses

Installation of turn mill machine will result in reduction of the utility system like turning & milling system to operate the numetic system and other general utility expanses due to fast rate of the production with comparision to the existing technology.

3.2 Monetary benefits

Monetary savings in a typical unit after installation of turn mill machine has been estimated around ` 17.62 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.

Note:-** *As in the proposed DPR* ***turning and milling machines are *replaced by Turnmill, it is assumed that it improves the overall productivity by 2 times i.e. 46.20 Tonnes/Annum in earlier case to 92.40 Tonnes/Annum after implementation. Accordingly, the energy saving could be achieved.*

3.3 Social benefits

3.3.1 Improvement in working environment

Manual measurement combined with subsequent program adjustments can take many hours for parts like this shaft that have complex features. However, WFL has developed canned probing cycles for its machines to automatically measure such parts and update the NC code for the finishing operations. For this work piece example, a touch probe measures specific points on the gear teeth in the center of the shaft. In doing so, the gear's pitch diameter is determined as is the true position of the gear centerline. The true position of the gear centerline is really what's important. That's because the machining code is automatically updated so all shaft features are machined to the gear's true (measured) centerline, not the machine's centerline. This ensures precise feature-to-feature accuracy after finish machining.

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 clean fuel based operation. No effluent generation or reduction will afect.

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 Turn mill Macxhine in machine tools industries. Reduction in electricity consumption translates into GHG reductions is estimated to be 65.8 tonnes of CO_2 per year.

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 SOX 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 Turn mill center are provided in Table 4.1 below:

Table 4.1 Cost of equipment

Sr. No.	Particulars	Cost
1	Turn mill center	` 4,838,400/-

The cost is calculated according to the rate of Rs 64 per Euro with 35% taxes and Duties

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

Sr. NO.	Particulars	Cost
1.	Cost of civil work	`1,60,200/-
2.	Cost of Consultancy and installation	`49,800/-
Total		**`210,000/-**

Total investment in the proposed technology (including equipment cost & Other cost) is ` 50.48 lakh.

4.2 Arrangements of funds

Proposed financing for the replacement of conventional machine with new turn mill center 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

Payback period will be 2.86 Years i.e. 34 Months.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 32.90 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 22.90 %. 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 21.12%.

Table 4.3 Financial indicator of proposed technology

Particulars	Unit	Value
Simple Pay Back period	Year	2.86
IRR	%age	22.90
NPV	` in lakh	32.90
ROI	%age	21.12
DSCR	ratio	1.69

4.4 Sensitivity analysis

In different situation fuel 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 4.4: Sensitivity analysis

Factors	Variation*	IRR	NPV in lakh	ROI	DSCR
Monetary Savings	0%	22.90%	32.90	21.12%	1.69
Monetary Savings	+5%	24.41%	36.76	21.83%	1.79
Monetary Savings	-5%	21.39%	29.03	20.81%	1.60

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

4.5 Procurement and implementation schedule

Total time period required for implementation of proposed machine will be 9 weeks. The installation of Turnmill center can be done in the 7 – 9 days, However the Turnmill center is end to end solution of Turning and milling machineing production process, implementation will not affect production. Thus implementation of this technology will not affect the process. Details of procurment and implementation schdeuls are furnished at Annexure 6.

ANNEXURE

Annexure – 1: Energy audit reports used for establishing

The results of detail energy audit for 3 units of Bangalore machine tool cluster is given below:

Audit No. 1 Energy Consumption Pattern of Machine Tools Cluster

.Particulars	Unit	Case - 1	Case - 2	Case - 3	Average
Specific Energy Consumption	kWh/Tonne	5879	1533	3976	3796
Average Energy Cost	`/Tonne	29395	7665	19880	18980
Cost of Material Rejection	`,/tonne	12500	4167	21505	12724
Other Cost (Man Power/Utility)	`/tonne	90000	90000	90000	90000
Average Production	`/tonne	131895	101832	131385	121704
Annual Production	Tonne	24	96	18.6	46.2
Annual Production Cost	`	3165480	9775872	2443761	5622725

Energy savings per year

S.No	Particular	Unit	Conventional machine	CNC Turn-Mill
1	Specific Energy Consumption	kWh/Tonne	3796	2847
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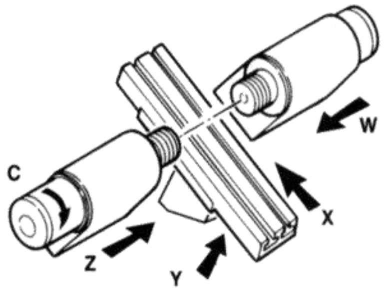
Note:-** *As in the proposed DPR* ***turning and milling machines are *replaced by Turnmill, it is assumed that it improves the overall productivity by 2 times i.e. 46.20 Tonnes/Annum in earlier case to 92.40 Tonnes/Annum after implementation. Accordingly, the energy saving could be achieved.*

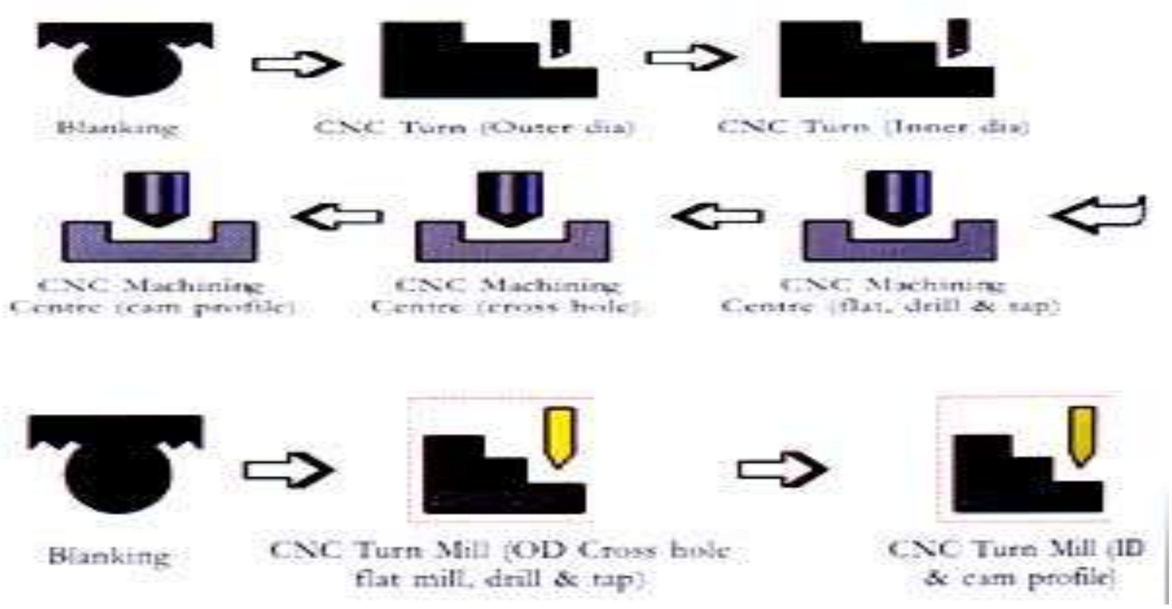
S. No	Particular	Unit	Conventional machine	CNC Turn-Mill
5	Average Production cost	`/tonne	121704	102629.8
7	Annual Production	Tonne/annum	46.2	92.4
8	Annual Production Cost	`/annum	5622725	9482920
9	Annual cost reduction	`/Annum	***1762438***	

And the saving reaches to the mark of **`** ***1762438*** (` 19074*92.4 tonne)

Annexure – 2: Process flow diagram



The turn-mill center is designed as a modular system equipped with two, three or four tool turrets. Thus, machining with as many as 80 fixed or driven tools is possible without a magazine. The machine processes geometrically complex series parts with a diameter of as much as 65 mm and a length of as much as 300 mm. 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.



Manual measurement combined with subsequent program adjustments can take many hours for parts like this shaft that have complex features. However, WFL has developed canned probing cycles for its machines to automatically measure such parts and update the NC code for the finishing operations. For this work piece example, a touch probe measures specific points on the gear teeth in the center of the shaft. In doing so, the gear's pitch diameter is determined as is the true position of the gear centerline. The true position of the gear centerline is really what's important. That's because the machining code is automatically updated so all shaft features are machined to the gear's true (measured) centerline, not the machine's centerline. This ensures precise feature-to-feature accuracy after finish machining.

Annexure – 3: Detailed technology assessment report

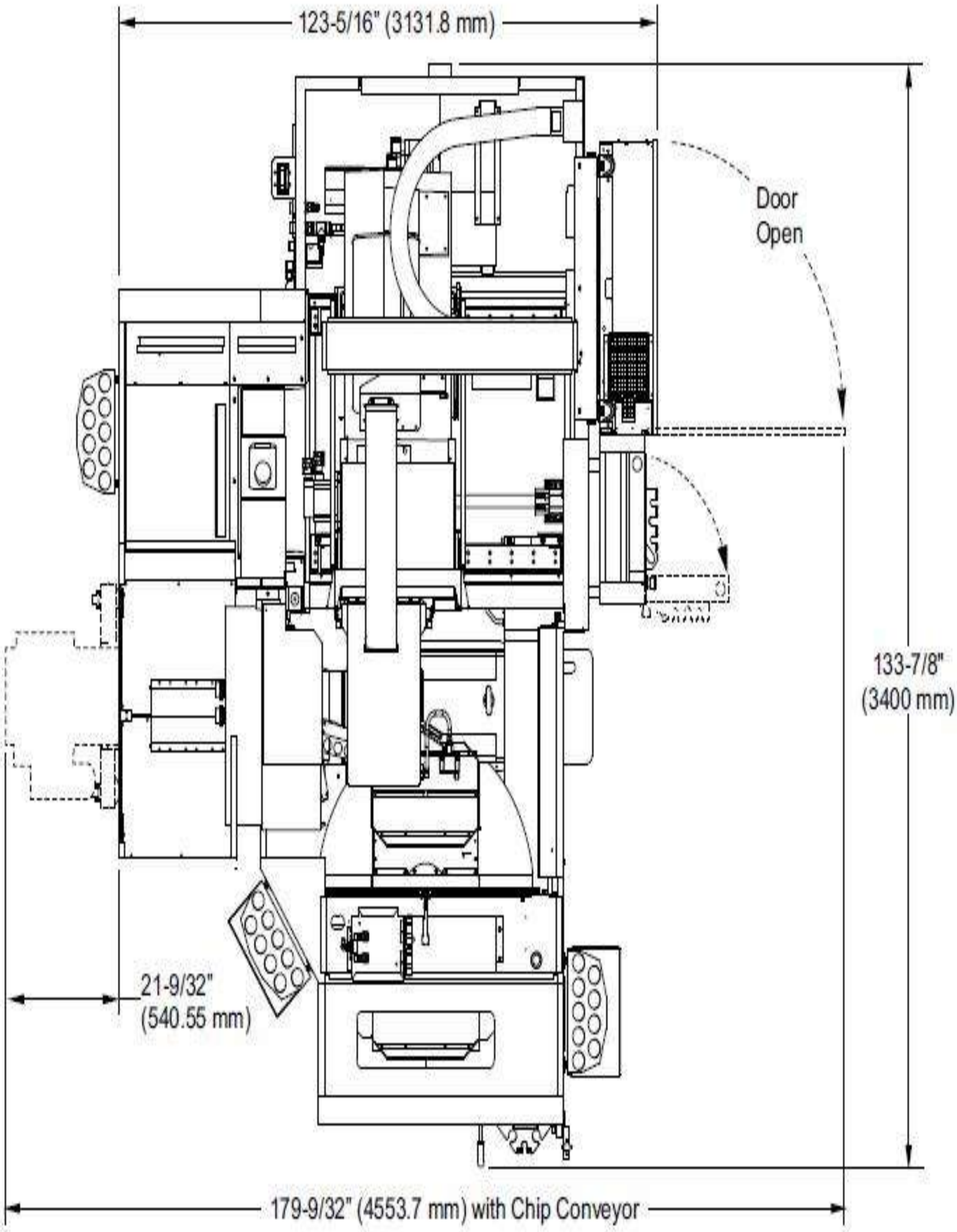
Turn-mills are attractive because they can oftentimes carry out all the operations needed to complete complex components like the shaft shown on the following page. In this case, an M50 Millturn machine from WFL Mill turn Technologies turns journals, mills gears, drills holes, and broaches internal splines and hobs external splines to complete the part.

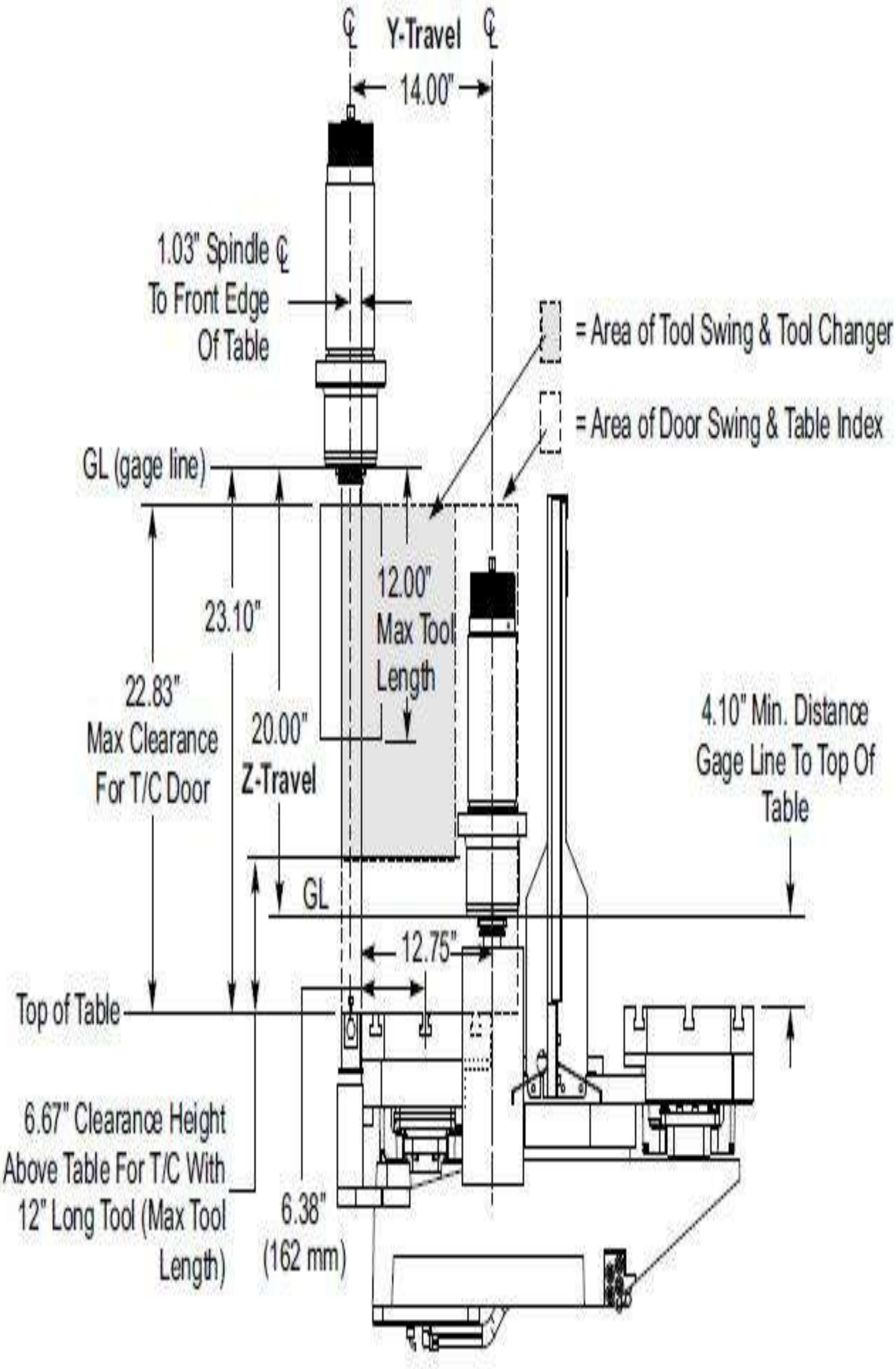
However, there's a twist: This shaft must be hardened. And that means two setups are required. Roughing operations are performed prior to heat treating rather than having the turn-mill (or "millturn" as WFL refers to it) machines the entire work piece in a hardened state. The workpiece must then be finish-machined on the M50 Millturn after it's hardened. Although heat treating brings the workpiece to the specified hardness, it also slightly "***bananas***" the shaft. As a result, the part must be carefully measured once it's reinstalled in the machine so that the program can be tweaked to compensate for the twisting distortion.

Annexure – 4 Drawings for proposed civil works

For proposed technology drawings are as follows

There is a no need to huge modification in civil work just need to built a solid basement for the turn mill center as per need of staging at the locations.




Y-Travel
14.00"
1.03" Spindle ℄ To Front Edge Of Table
= Area of Tool Swing & Tool Changer
= Area of Door Swing & Table Index
GL (gage line)
23.10"
12.00" Max Tool Length
22.83" Max Clearance For T/C Door
20.00" Z-Travel
4.10" Min. Distance Gage Line To Top Of Table
GL
12.75"
Top of Table
6.67" Clearance Height Above Table For T/C With 12" Long Tool (Max Tool Length)
6.38" (162 mm)

Annexure – 5 Detailed financial calculations & analysis for financial indicators

Assumption

Name of the Technology	**CNC Turn Mill Centre**		
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)	48.38	Feasibility Study
Cost of modification in civil construction	` (in lakh)	1.60	Feasibility Study
Cost of consultancy	` (in lakh)	0.50	Feasibility Study
Total Investment	` (in lakh)	50.48	Feasibility Study
Financing pattern			
Own Funds (Equity)	` (in lakh)	12.62	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	37.86	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kWh/Tonne	949	
Annual production	Tonne/Annum	92.4	
Cost	`/kWh	5	
Other savings	`/Annum	14329.2	
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	37.86	2.10	35.76	4.39
2	35.76	4.80	30.96	3.36
3	30.96	5.00	25.96	2.88
4	25.96	5.20	20.76	2.37
5	20.76	5.50	15.26	1.83
6	15.26	6.00	9.26	1.25
7	9.26	6.20	3.06	0.65
8	3.06	3.06	0.00	0.09
		37.86		

WDV Depreciation

Particulars / years	1	2
Plant and Machinery		
Cost	50.48	10.10
Depreciation	40.39	8.08
WDV	10.10	2.02

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Revenue through Savings										
Total Revenue (A)	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62
Expenses										
O & M Expenses	2.02	2.12	2.23	2.34	2.45	2.58	2.71	2.84	2.98	3.13
Total Expenses (B)	2.02	2.12	2.23	2.34	2.45	2.58	2.71	2.84	2.98	3.13
PBDIT (A)-(B)	15.61	15.50	15.40	15.29	15.17	15.05	14.92	14.78	14.64	14.49
Interest	4.39	3.36	2.88	2.37	1.83	1.25	0.65	0.09	-	-
PBDT	11.22	12.15	12.52	12.92	13.34	13.79	14.27	14.69	14.64	14.49
Depreciation	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
PBT	8.55	9.48	9.86	10.26	10.67	11.13	11.60	12.03	11.98	11.83
Income tax	-	1.38	4.26	4.39	4.53	4.69	4.85	4.99	4.98	4.93
Profit after tax (PAT)	8.55	8.10	5.60	5.86	6.14	6.44	6.75	7.03	7.00	6.90

Computation of Tax

`(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Profit before tax	8.55	9.48	9.86	10.26	10.67	11.13	11.60	12.03	11.98	11.83
Add: Book depreciation	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Less: WDV depreciation	40.39	8.08	-	-	-	-	-	-	-	-
Taxable profit	(29.17)	4.07	12.52	12.92	13.34	13.79	14.27	14.69	14.64	14.49
Income Tax	-	1.38	4.26	4.39	4.53	4.69	4.85	4.99	4.98	4.93

Projected Balance Sheet ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Liabilities										
Share Capital (D)	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.62
Reserves & Surplus (E)	8.55	16.65	22.25	28.12	34.25	40.69	47.45	54.48	61.48	68.38
Term Loans (F)	35.76	30.96	25.96	20.76	15.26	9.26	3.06	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	56.94	60.24	60.84	61.50	62.14	62.58	63.13	67.10	74.10	81.00
Assets										
Gross Fixed Assets	50.48	50.48	50.48	50.48	50.48	50.48	50.48	50.48	50.48	50.48
Less: Accm. Depreciation	2.67	5.33	8.00	10.66	13.33	15.99	18.66	21.32	23.99	26.66
Net Fixed Assets	47.82	45.15	42.49	39.82	37.16	34.49	31.83	29.16	26.49	23.83
Cash & Bank Balance	9.12	15.08	18.35	21.68	24.98	28.09	31.30	37.94	47.61	57.17
Total Assets	56.94	60.24	60.84	61.50	62.14	62.58	63.13	67.10	74.10	81.00
Net Worth	21.17	29.27	34.87	40.74	46.87	53.31	60.07	67.10	74.10	81.00
Dept equity ratio	2.83	2.45	2.06	1.65	1.21	0.73	0.24	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	12.62	-	-	-	-	-	-	-	-	-	-
Term Loan	37.86										
Profit After tax		8.55	8.10	5.60	5.86	6.14	6.44	6.75	7.03	7.00	6.90
Depreciation		2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Total Sources	50.48	11.22	10.76	8.27	8.53	8.80	9.11	9.42	9.70	9.66	9.57
Application											
Capital Expenditure	50.48										
Repayment of Loan	-	2.10	4.80	5.00	5.20	5.50	6.00	6.20	3.06	-	-
Total Application	50.48	2.10	4.80	5.00	5.20	5.50	6.00	6.20	3.06	-	-
Net Surplus	-	9.12	5.96	3.27	3.33	3.30	3.11	3.22	6.64	9.66	9.57
Add: Opening Balance	-	-	9.12	15.08	18.35	21.68	24.98	28.09	31.30	37.94	47.61
Closing Balance	-	9.12	15.08	18.35	21.68	24.98	28.09	31.30	37.94	47.61	57.17

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

Particulars / months	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Profit after Tax		8.55	8.10	5.60	5.86	6.14	6.44	6.75	7.03	7.00	6.90
Depreciation		2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Interest on Term Loan		4.39	3.36	2.88	2.37	1.83	1.25	0.65	0.09	-	-
Cash outflow	(50.48)	-	-	-	-	-	-	-	-	-	-
Salvage value											30.44
Net Cash flow	(57.10)	15.34	14.46	11.10	10.83	10.55	10.24	9.91	9.56	9.41	36.25
IRR	22.90%										
NPV	32.90										

Break Even Point ` *(in lakh)*

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Variable Expenses										
O & M Cost	1.51	1.59	1.67	1.75	1.84	1.93	2.03	2.13	2.24	2.35
Sub Total (G)	1.51	1.59	1.67	1.75	1.84	1.93	2.03	2.13	2.24	2.35
Fixed Expenses										
Operation & Maintenance Exp (25%)	0.50	0.53	0.56	0.58	0.61	0.64	0.68	0.71	0.75	0.78
Interest on Term Loan	4.39	3.36	2.88	2.37	1.83	1.25	0.65	0.09	0.00	0.00
Depreciation *(H)*	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Sub Total (I)	7.56	6.55	6.10	5.62	5.11	4.56	3.99	3.47	3.41	3.45
Sales (J)	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62	17.62
Contribution (K)	16.11	16.03	15.95	15.87	15.78	15.69	15.59	15.49	15.39	15.28
Break Even Point (L= G/I) (%)	46.90%	40.87%	38.22%	35.39%	32.40%	29.08%	25.60%	22.38%	22.17%	22.58%
Cash Break Even {(I)-(H)} (%)	30.36%	24.25%	21.51%	18.59%	15.51%	12.09%	8.51%	5.17%	4.85%	5.13%
Break Even Sales (J)*(L)	8.27	7.20	6.74	6.24	5.71	5.12	4.51	3.94	3.91	3.98

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

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Net Profit Before TAxis	8.55	9.48	9.86	10.26	10.67	11.13	11.60	12.03	11.98	11.83	107.38
Net Worth	21.17	29.27	34.87	40.74	46.87	53.31	60.07	67.10	74.10	81.00	508.51
ROI	21.12 %										

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

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Cash Inflow										
Profit after Tax	8.55	8.10	5.60	5.86	6.14	6.44	6.75	7.03	7.00	6.90
Depreciation	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Interest on Term Loan	4.39	3.36	2.88	2.37	1.83	1.25	0.65	0.09	0.00	0.00
Total (M)	15.61	14.12	11.14	10.90	10.64	10.36	10.07	9.79	9.66	9.57

Debt

Interest on Term Loan	4.39	3.36	2.88	2.37	1.83	1.25	0.65	0.09	0.00	0.00
Repayment of Term Loan	2.10	4.80	5.00	5.20	5.50	6.00	6.20	3.06	0.00	0.00
Total (N)	6.49	8.16	7.88	7.57	7.33	7.25	6.85	3.15	0.00	0.00
Average DSCR (M/N)	1.69									

*Note: **-** *As the proposed machinery is CNC Turn Mill center 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 – 6: Details of procurement and implementation plan

S. No.	Activities	Weeks								
		1	2	3	4	5	6	7	8	9
1	Preparation									
2	Procurement and Delivery									
3	Civil & Electrical Work									
4	Commissioning									
5	Training									
6	Trial									

Annexure – 7 Details of technology/equipment and service providers

List

- **Ace Micromatic Machine Tools Pvt.Ltd**

    Add: Plot no.533, 10th main,

    4th Phase, Peenya Industrial area,

    Bangalore-560058

- **DMG Mori Seiki India Machines and Services Pvt Ltd**

    Add: Parimala Towers"

    #64 Jalahalli Camp Cross,

    Off MES Road, Yeshwanthpur

    PIN-560022 Bangalore. Phone: +91 80 40896508

- **Haas Automation**

  Add: Manav Marketing Pvt Ltd

    430-431,12TH cross,

    4th Phase,Peenya Industial Area,

    Bangalore 560058

  India

  Phone:91-80-4117 9452/53 Fax: 91-80-4117 9451 manav@giasbg01.vsnl.net.in

- **Jyoti CNC automation Pvt.ltd,**

    No.7, 6th Main Road, Shrikanteswara Nagar,

    Mahalakshmipuram Lay out,

    Bangalore

- **Mazak company,**

    Concord Towers,

    14th Floor, UB City,

    Bangalore

Annexure – 8 Quotations or Techno-commercial bids for new technology/equipment

DMG — innovative technologies
www.gildemeister.com

Price Specification

CTX 310 eco V3 Turn Mill Center

Highlights

_ **VDI 30 revolver** with 12 tool stations, up to 6 driven tools, and **C-Axis**
_ **User-friendly Siemens 810D with ShopTurn,** direct DMG SMARTkey for individual use
_ **Simple programming** – 15" TFT SlimLinePanel
_ **Comprehensive tool management** with visual representation
_ **Visual support** for setup and diagnosis
_ **Highly dynamic spindle motor** with 11 KW, 112 Nm and 5,000 rpm
_ **Digital drives and linear roller guideways** in all axes for highest dynamics and superb precision
_ **Automatically traversing tailstock** for superior machining flexibility

DMG MORI SEIKI

05/08/2010
Transport zone: India: Sheva/Chennai/Mumbai

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FAMOT
CTX 310 eco

Price Specification

EUR

Basic machine

C-A2675 CTX 310 eco V3
Turning centre with CNC control
and SlimLinePanel, incl.
Chip Tank
Hydraulic hollow clamping attachment,
max. bar capacity Ø 51 mm
Hydraulic chuck 3 jaws 210 mm,
make Autogrip, type 3H08-Z140

C-A1710* CNC control SIEMENS SINUMERIK 810D
with ShopTurn

C-P7100 Chip Removal Package:
- chip conveyor
- additional set (3 pieces) of soft jaws (210mm)
- 4 colour signal lamp

C-Z2310 Coolant Spray Gun

Services

C-O3134 Despatch costs machine

C-Y0006 Seafreight Packing: wooden base and vacuum foil

The Total cost of the machine on CIF Chennai basis will be EUR 77,000=00

The best package price on CIF Chennai basis will be EUR 56,000=00

CTX 310 eco / Series FEF103 valid 29/11/2010 - 25/03/2011 / Price status: 05/08/2010

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

PCRA, Southern Region
Petroleum Conservation Research Association T.M.B. Mansion, First Floor, 739, Anna Salai,
Chennai – 600002

System & Solution (India)
www.sas.ind.in
ems@sas.ind.in

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri,
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