DETAILED PROJECT REPORT
ON
CONVENTIONAL BENDING MACHINE TO CNC BENDING MACHINE
(BANGALORE MACHINE TOOL CLUSTER)











Bureau of Energy Efficiency

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REPLACEMENT OF CONVENTIONAL BENDING MACHINE

WITH

CNC BENDING MACHINE

OR

NEW CNC BENDING MACHINE

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

Detailed Project Report on Replacement of conventional Bending Machine with CNC Bending Machine or new CNC Bending Machine

Bangalore Machine Tool cluster, Karnataka (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.:

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Acknowledgement

We are sincerely thankful to the Bureau of Energy Efficiency, Ministry of Power, for giving us the opportunity to implement the 'BEE SME project in Bangalore Machine Tool cluster'. We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

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Petroleum Conservation Research Association is also thankful to "Karnataka Small Scale Industries Association, Bangalore, Peenya Industrial Association, Bangalore and Bangalore Machine Tool manufacturers Association, Bangalore" for their valuable inputs, co-operation, support and identification of the units for energy use and technology audit studies and facilitating the implementation of BEE SME program in Bangalore Machine tools cluster.

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.

PCRA is also thankful to all the SME owners, plant in charges and all workers of the SME units for their support during the energy use and technology audit studies and in implementation of the project objectives.

Petroleum Conservation Research Association

Bangalore.

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List of Abbreviations

BEE	Bureau of Energy Efficiency
MSME	Micro Small and Medium Enterprises
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.

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 recommendations made in the cluster manual is listed below:

Replacement of conventional Bending Machine with CNC Bending Machine or new CNC Bending Machine

Designed to reduce setup time and enhance production, CNC tube bending machines from feature electrical servo-drives on all axes and are available in single and multistack versions. Multistack benders allow complex bending without tool change. If a multistack tool cannot be applied for stability reasons, an automated clamp die changing system that accommodates up to eight clamp dies is available. The machines feature programmable bending procedures and boosting by the transport carriage, including boosting in the pressure die area. This boosting reduces wall thinning at the outer bend and allows narrow bends. A radius of less than 1 x OD can be achieved. Other features include an MMI Multicontrol 2020 system; TFT monitor; touch screen; plausibility verification; XYZ coordinate recalculation into bending parameters; flexible programming; multitasking; and 3-D displays. Remote maintenance and technology support are provided by an integrated modem and the Internet. And under proper maintenance will serve the owner for a period of 18 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)	36.35
2.	Electricity saving	kWh	312
3.	Monetary benefit	` (in lakh)	26.07
4.	Simple payback period	Year	1.39
5.	NPV	` (in lakh)	68.53
6.	IRR	%age	53.38
7.	ROI	%age	27.39
8.	DSCR	ratio	2.98
9.	CO_2 reduction	Tonne	
10.	Procurement and implementation schedule	week	11

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
- Peenya
- Bommasandra

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.

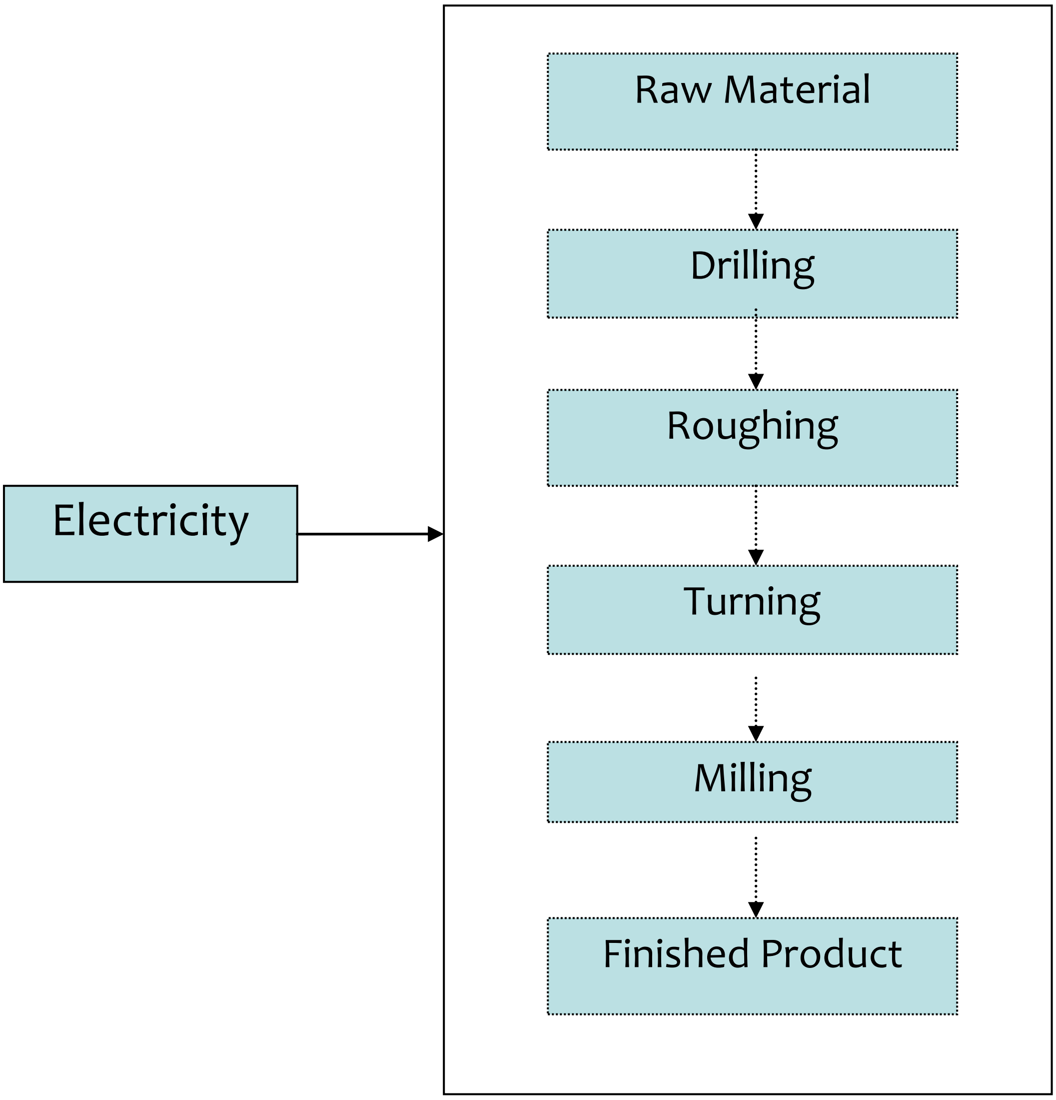
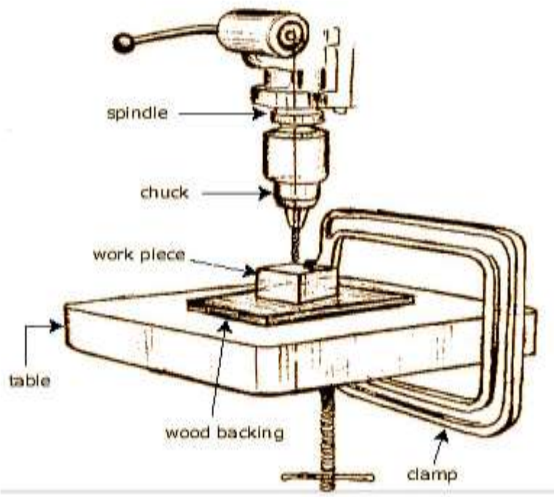


Figure 1.1 Process flow chart of typical Machine Tools Unit

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.

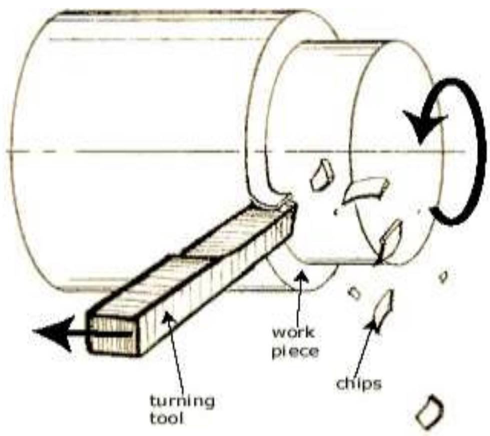
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

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.

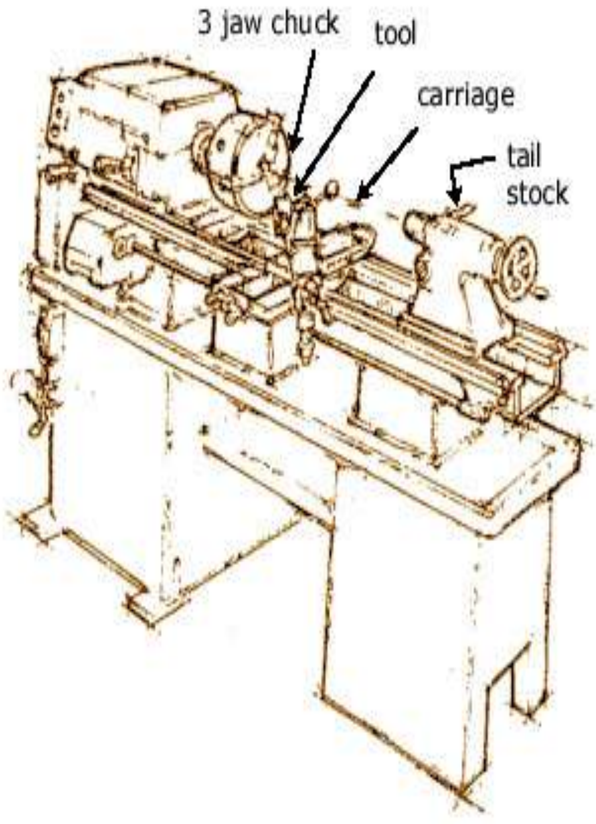
When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

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 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.

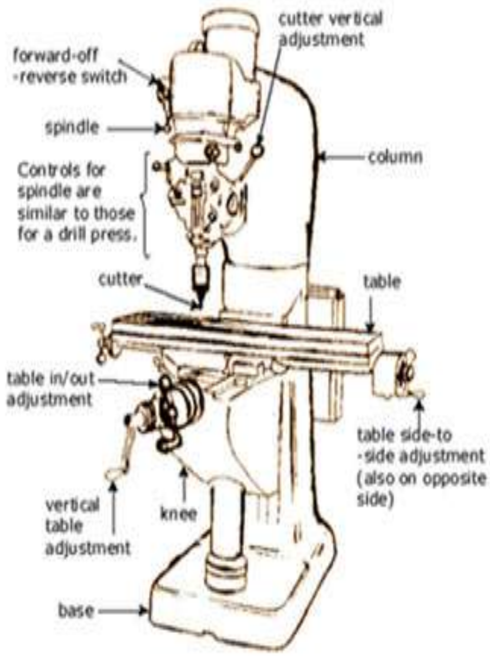
There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Lineboring (line boring, line-boring) implies the former. Backboring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

- ***Knurling***

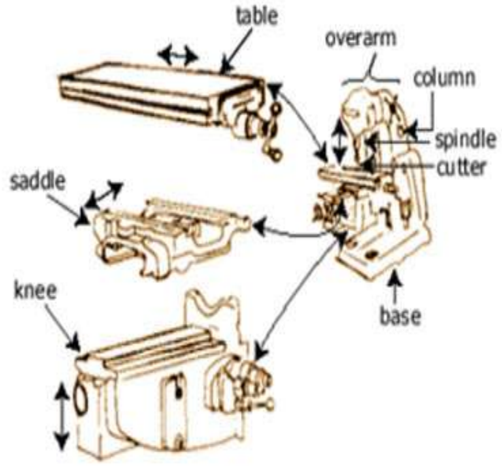
The cutting of a serrated pattern onto the surface of a part to use as a hand grip using a special purpose knurling tool. Threading both standard and non-standard screw threads can be turned on a lathe using an appropriate cutting tool. (Usually having a 60, or 55° nose angle) Either externally, or within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



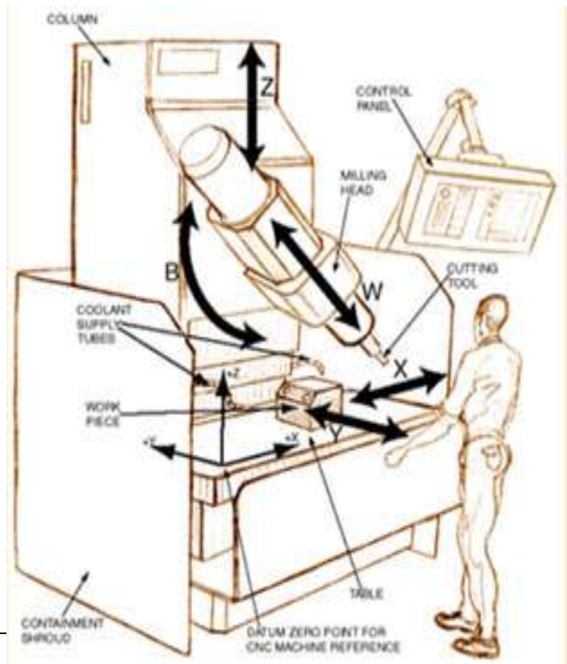
Milling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three-dimensional surface contours. Parts that are fabricated completely through milling often include components that are used in limited quantities, perhaps for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

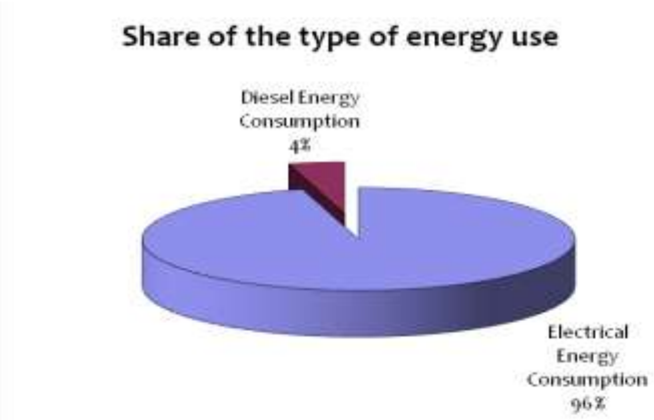


Figure 1.2: Share of Energy Type used in the Machine Tool Units

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

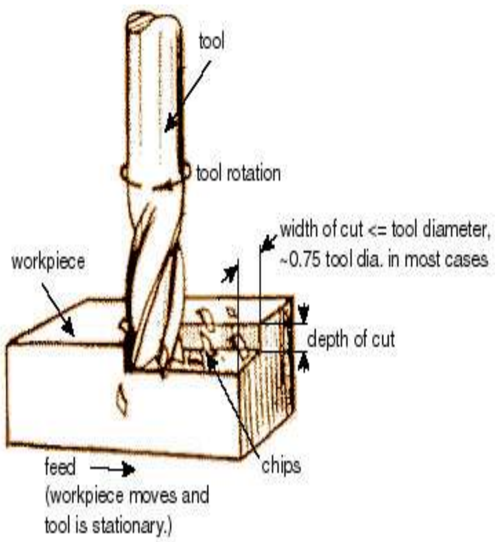
The machine tools industry can be divided into metal cutting and metal forming sectors. The metal cutting sector can be further classified into conventional and computer numerically controlled (CNC) machines, while the metal forming sector can be segregated into conventional and numerically controlled (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. 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 ` Rs.28374 per tonne and Rs.`3702814 annually.

Table 1.2 Energy Consumption Pattern of Existing Technology

Particular	Unit	Value
Specific Energy Consumption	kWh/Tonne	975
Average Energy Cost	`/Tonne	4875
Reduction in Rejection rate	`/Tonne	13500
Other Cost (Man Power/Utility)	`/Tonne	10000
Average Production cost	`/Tonne	28375
Annual Production	Tonne	130.5
Annual Production Cost	`/annum	3702938

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	1,27,212	458	100

****Based on measured actual electricity consumption by the existing technology (130.5 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:

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

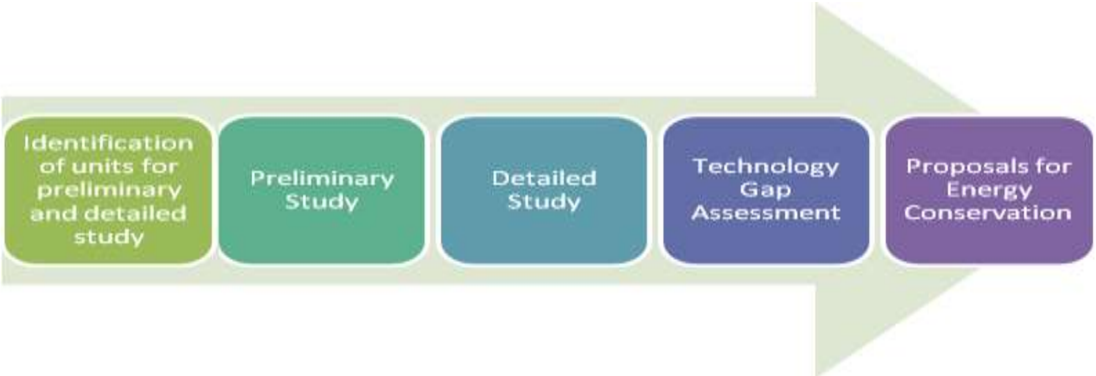


Figure 1.3 Energy auditing methodology

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. The bending machine tubing bender is a programmable control machine that can bend up to 2-1/2" tubing and 2" schedule 40 pipes. The standard control allows up to 170 programs with 10 bends per program. Optional indexing tables give repeatability for both rotation points and length measurements between bends. Tables up to 20' long are available. This rotary draw tube bender can bend at speeds up to 9 seconds for a 180° bend and can be programmed to bend up to 360°, great for solid rod applications. Complex serpentine bends can be done with ease.

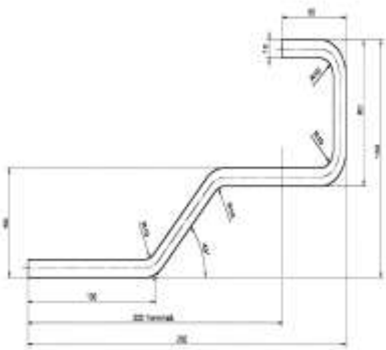
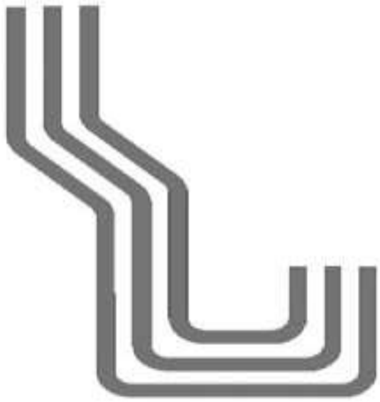
A quick counter die release allows for easy removal of bends. The counter die positioned has a numerical counter so repositioning of the counter die is a breeze when recalling bend programs. Engaging bends is as simple as pressing the forward foot pedal, and reverse pedal when complete The bending machine Professional is an exceedingly powerful CNC bending machine with spring back compensation. It is able to bend single pieces as well as small batches with the same precision and efficiency as series-produced parts. A bending accuracy of +/- 0.2° starting from the first work piece is achieved due to calculated spring back compensation and the use of electronic tools. The latest SV version supports an operation speed of up to 50 mm/s. Tools are changed quickly by using the simple plug-in system. With a bending force of 400 kN, bending machine is able to bend materials of up to 200x 20 mm (copper). The hydraulic cylinders are located under the working face to allow for a maximum amount of work space. Special bending tools render even complex bends possible.

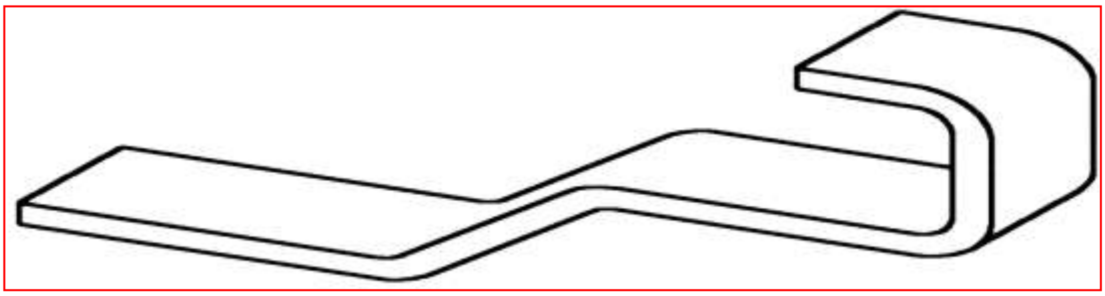
The bending machine features a CNC stop with a traverse path of approximately 1500 mm. Additional extensions are available on request. The bending software Power Bend accurately calculates the flat length as well as the stop position and transfers the results directly to the CNC control unit. High production accuracy is assured. The bending machine features accuracy about 0.1º. This is attained by using bending prisms with electronic angular measurement technology. The computer then calculates the required final stroke. The spring back of every bend is compensated regardless of material type. Our high angle accuracy of +/- 0.2º is achieved instantly with the first work piece. No adjustments are required. Material waste amounts will drop considerably. Even inconsistencies within a single piece of material are automatically adjusted. If the bending prisms with integrated angular measurement cannot be used due to their size, bending prisms without angular measurements can be used. Perhaps the distance between two bends is too short. In such cases the control unit can be switched from angular to stroke measurement. This method allows the selection of the bending ram distance. Setting accuracy is +/- 0.1 mm. A final stroke is usually not required. For tight and narrow U-bends, the bending tool can be turned around and moves toward the operator. The stroke movement is then performed by the bending prism.

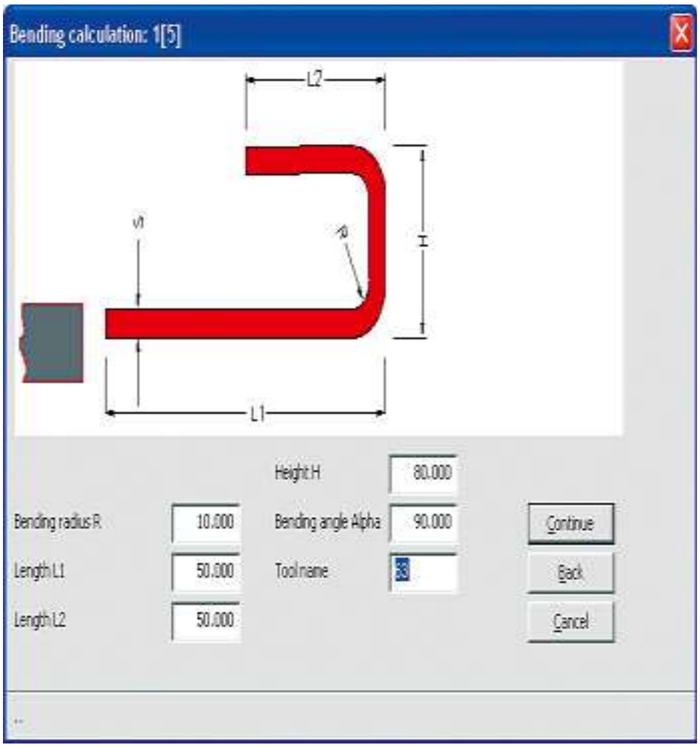
Bends with openings from 40 mm and an accuracy of 0.2° are possible. Special bending tools that include electronic angular measurement allow a high bending accuracy even when bending on edge is required. The stroke system also enables the user to specify an angle from which the stroke is calculated by using stored stroke functions. Bending accuracy in that case is dependent upon material properties such as thickness, hardness, etc. These properties may differ from one piece of material to anothe

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 Bending Machine operations

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Bending angle Alpha
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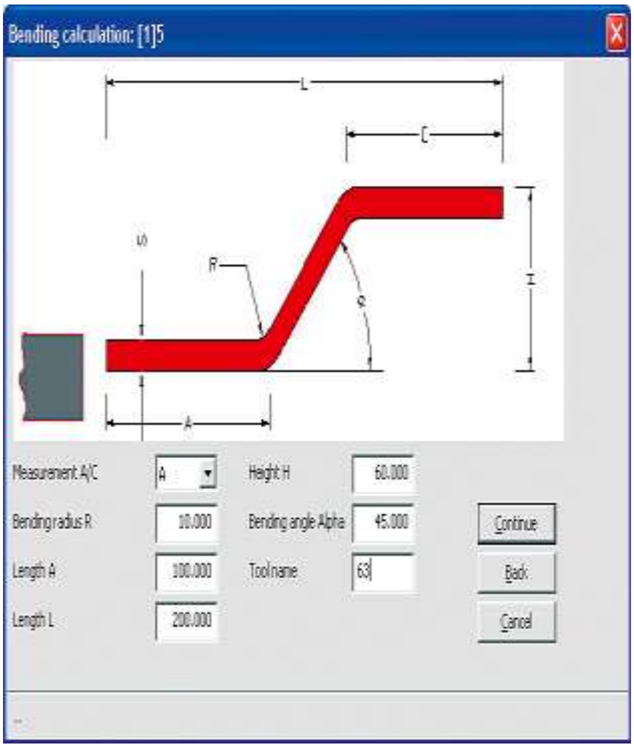
Bending calculation: [1]5
Measurement A/C
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Bending radius R
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Length L
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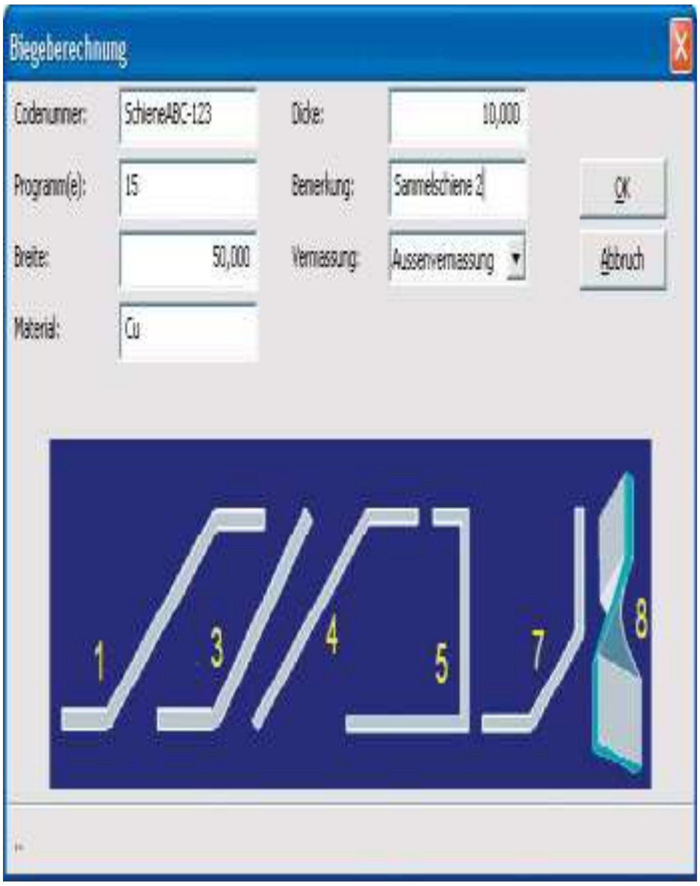
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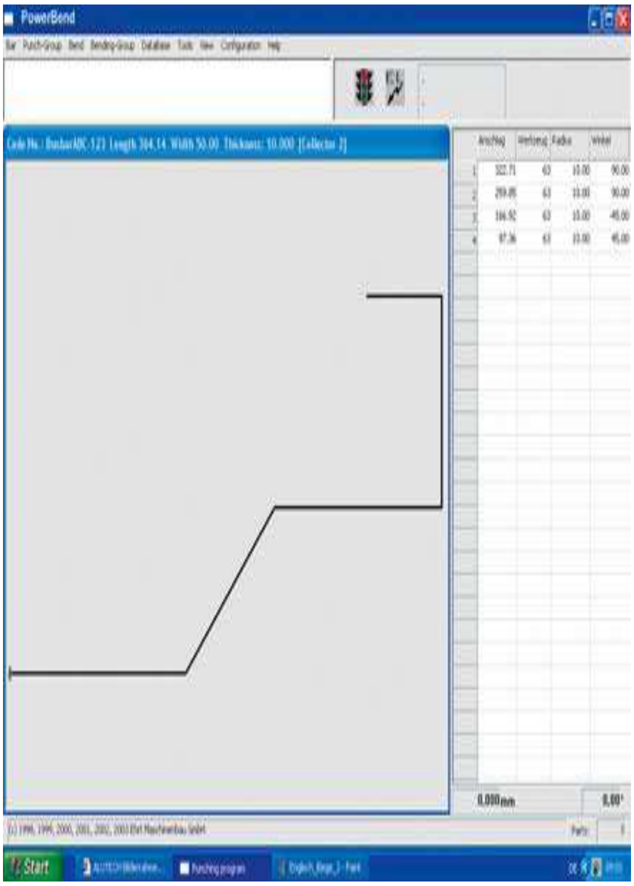

PowerBend
Start

Figure 2.1 CNC Bending Machine operations

With a bending force of 400 kN, the EB 40 Professional is able to bend materials of up to 200x 20 mm (copper). The hydraulic cylinders are located under the working face to allow for a maximum amount of work space. Special bending tools render even complex bends possible. CNC stop with a traverse path of approximately 1500 mm. Additional extensions are available on request. The bending software Power Bend accurately calculates the flat length as well as the stop position and transfers the results directly to the CNC control unit. High production accuracy is assured.. This machine is our most ergonomic machine to date. Measuring accuracy is 0.1º. This is attained by using bending prisms with electronic angular measurement technology. The computer then calculates the required final stroke. The spring back of every bend is compensated regardless of material type. Our high angle accuracy of +/- 0.2º is achieved instantly with the first work piece. No adjustments are required. Material waste amounts will drop considerably.

Even inconsistencies within a single piece of material are automatically adjusted. For tight and narrow U-bends, the bending tool can be turned around and moves toward the operator. The stroke movement is then performed by the bending prism. Bends with openings from 40 mm and an accuracy of 0.2° are possible. Special bending tools that include electronic angular measurement allow a high bending accuracy even when bending on edge is required. If the bending prisms with integrated angular measurement cannot be used due to their size, bending prisms without angular measurements can be used. Perhaps the distance between two bends is too short. In such cases the control unit can be switched from angular to stroke measurement. This method allows the selection of the bending ram distance. Setting accuracy is +/- 0.1 mm. A final stroke is usually not required.

The stroke system also enables the user to specify an angle from which the stroke is calculated by using stored stroke functions. Bending accuracy in that case is dependent upon material properties such as thickness, hardness, etc. These properties may differ from one piece of material to another. The Microsoft Windows® based software, Power Bend, is easy to learn since there are no CNC programming skills required. Training is accomplished smoothly. All necessary inputs are prompted and displayed on the screen. Inputs can be corrected at any time and minimum distances are checked instantly to guard against improper inputs. The operator is allowed to use outside, inside, center line, and radius dimensions. Software can be switched between mm and inches. The software offers 6 different bending elements, which can be combined with one another. For example, this 4-bend sample is split into 2 bending operations.

The first operation is a Z-bend (bending operation no.1) and the second operation is a U-bend (bending operation no. 5). The dividing line (see illustration) can be placed at any position. The software then asks for all necessary values and checks all figures, allowing errors to be corrected immediately. These figures are used to calculate the developed length and the side stop position. A graphic of the bend work piece is then shown. The PowerBend software automatically calculates the flat length of each part being bent and determines the exact position of the side stop. Up to 15 bends can be calculated for one work piece. PowerBend offers a very easy solution for calculating parallel bars. The required distance between bars and the new name for the parallel bar is input. PowerBend automatically does a new calculation of the geometry, the developed length and the new sides stop position. The program for each work piece can be stored as alphanumeric names up to 24 digits. The database allows storage of up to 200,000 different parts which can be located easily using the search and sort options. Networking with other Bending machines and external workstation is easy. Parts can be programmed externally and quickly transferred which increases the overall productivity of the machine. It is possible to network with other Bending machines and offline work stations. A simple transfer of parts programmed offline increases the productivity of the machine. PowerBend offers a very easy solution for calculating parallel bars. The required distance between bars and the new name for the parallel bar is input. PowerBend automatically does a new calculation of the geometry, the developed length and the new sides stop position.

2.1.3 Technology specification

Table 2.1 Equipment Speciation

Technical Data		
Application	**specification**	**Value**
Press Capacity	400 KN	
Bending System	Hydraulic	
Hydraulic Pressure	300 bar	
Bending Accuracy	0.2°	
Workpieces	max. 200 x 20mm	7.87“ x 0.79“
Rapid Movement	50 mm/s	1.97“/s
Inching	10 mm/s	0.4“/s
Stroke	max. 200 mm	7.9“
Return Stroke	adjustable	
Working Height	975 mm	38.4“
Electrical Standards	according to VDE	
Electrical Connected Load	7.5 KW	
Side Stop	digital DC servomotor with reticulating ball screw	
Software	Power Bend	
Control Unit	industrial PC running Windows XP or higher	
Finishing	RAL 5010 Gentian Blue	
Doors and Coverings	RAL 7035 Light Grey	
Safety Installations	all danger zones are secured according to CE standards	

2.1.4 Suitability or integration with existing process

All bending machines are fabricated from 30mm square section tubing to provide a rock solid frame which more than stands up to the rigors of daily use. The frame is designed to give maximum stability, minimizing the risks of sideways movement or skidding across floors, making operation as easy and effective as possible. The formers which are key to creating a perfect bend are machined cast aluminum. This means they can provide a superior and highly accurate bend as the machined area provides a perfect profile to support the pipe and gives excellent contact and virtually no movement. By comparison, most other brands use non machined die casts. Included with all machines is a dual purpose stabilizing and extension bar. It can be used to give extra leverage when performing down-bends or to give extra stability to up-bends by acting as a counter-lever. For electricians, the bar can also be used as a handy cable reel feed by simply securing it through holes in the vice mount, further adding to its versatility. When not in use the bar can be stored securely out of the way on the side of the machine.

2.1.5 Superiority over existing technology

The CNC Bending 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. Protection for the operator and anyone near the machine may be provided by a combination of devices. These include trip devices and hold to run controls, together with suitable safe systems of work. These safety devices do not directly prevent entanglement or entrapment. They are intended to help prevent or minimize injury in the event of entanglement etc, by quickly stopping the machine. Operators should therefore be trained to use the safety devices correctly. Managers should ensure that the safety devices are properly installed, maintained and used.

Machines should be provided with hold to run controls which ensure that roll movement only occurs when the control is held in the run position. The control should automatically return to the stop position when released. This type of control may take the form of a button, joystick or foot switch Machines should be provided with hold to run controls which ensure that roll movement only occurs when the control is held in the run position. The control should automatically return to the stop position when released. This type of control may take the form of a button, joystick or foot switch A trip device (bar or tensioned wire) should be positioned so that it may be easily actuated by any person caught or drawn towards the rolls and will stop the machine before serious injury can occur. The trip device will be required at both sides of a machine. Mechanical trip bars including kick panels should be provided with two safety interlock switches (normally closed), one at each end of the bar or panel. Alternatively rotary cam switches may be used operating off the pivot pins. The switches should be arranged to actuate on minimal deflection of the bar or pane. In addition to the measures detailed above, an emergency stop button should be provided at the machine control console and at any remote work station.

Emergency stop buttons should be of the ‘lock in’ type so that the machine cannot be restarted until they have been reset manually. Release or resetting of the emergency stop should not cause the machine to operate - starting should only be possible by operating the normal ‘start’ control. The emergency stop device should actuate the brake if fitted. Supervisors should ensure that safe working methods are followed. In particular the following should be considered:

- The use of gloves with fingertips during initial feeding of workpieces should be prohibited because the tips can be caught and drawn into the roll intake. Where there is a genuine need for hand protection, palm protection only may be sufficient. Loose fitting clothing should not be worn. Overalls with close fitting cuffs and sleeves are preferred;
- Workpieces should always be held sufficiently far back from the edge being fed into the rolls to allow for the infeed speed of the machine, and therefore prevent close hand approach to the rolls. Where the nature of the work permits, suitable handling aids such as feed tables or rollers should be used;
- The area around the machine should be adequately lit and kept free of materials which might cause slips or trips. When more than one operator is involved with the work, clear operating procedures should be established before work commences.
- Affordable
- Pedestal or vice mount
- Easy operation
- Mechanical or hydraulic
- Quick change dies
- Large radius degree wheel
- Hydraulic powered
- Simple set up and operation
- Round & square tubing
- Close bend-to-bend distances
- Accurate bends to 180°
- Adjustable bend die on lead screw
- 3D and 5D bends from each die set
- Replaceable parts for long service life
- Durable heavy duty steel construction
- Rugged CNC machined steel construction
- Self locking ratchet prevents material spring back

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 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.

2.1.8 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 bending machines can be done in the 5 - 7 days, However the CNC Bending machine is end to end solution of bending 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 Bending machine, the technology and machine will continue to work up to 15 to 18 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 Bending machine is suitable for the units involved in the production of more fast bending than conventional Bending machine 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 bending Machines are rapidly replacing the older production bemding machines 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 machine, and once set and trialled the machine will continue to bend 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. 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 main advantage of CNC bending 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 bends 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 bending 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	975	663.33
2	Average Energy Cost	`/Tonne	4875	3316.65
3	Cost of Material Rejection	`/Tonne	13500	8115
4	Other Cost (Man Power/Utility)	`/tonne	10000	5528.6
5	Average Production	`/tonne	28375	16960.25
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/annum	3702938	2213312.63
8	Reduction in Production Cost	`/Tonne	11413.8	
9	Annual cost reduction	`/Annum	1489500.9	

A CNC bending 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 any users of CNC bending machine revels that the CNC bending machine may produce two times production/ material at same time and at same energy consumption. The CNC bending machines gives us the annual savings of `14.9 lakh and of `11414 per Tonne produced

A CNC Bending 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 Bending machine revels that the CNC bending machine may produce two times production/ material at same time and at same energy consumption.

***Note:-** *As in the proposed DPR Conventional Bending machine is replaced by CNC Bending 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 bending 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 bending machine with comparision to the exisitng manual set up based product. The rejection of material in CNC bending machining is almost nill while comparing with existing system/technology. Finally, high-speed bending 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 CNC bending 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 bending 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 bending 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 bending 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.

3.2 Monetary benefits

Monetary savings in a typical unit after installation of CNC bending machine has been estimated around `26.07 lakh per annum and `11414 per tonne produced. 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 bending 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 POWERBEND, the entry price of CNC bending 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 58.51 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 bending machine are provided in Table 4.1 below:

Table 4.1 Cost of equipment

S. No.	Particulars	Cost
1	Cost of CNC bending machine	` 3435261

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

S. NO.	Particulars	Cost
1.	Cost of civil work	` 135,000/-
2.	Electrical & Utility Expanses	` 35,000/-
3.	Cost of Consultancy and installation	` 30,000/-
Total	Rupees Two Hundred thousand only/-	` 200,000/-

Total cost of the project is ` 36.35 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 1.39 years.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 68.53 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 53.38%. 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 27.39 %.

Table 4.4 Financial indicator of proposed technology

Particulars	Unit	Value
Simple Pay Back period	Years	1.39
IRR	%age	53.38
NPV	` in lakh	68.53
ROI	%age	27.39
DSCR	ratio	2.98

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.

Electricity saving increase by 5%

Electricity saving decrease by 5%

Table 4.5: Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	53.38%	68.53	27.39%	2.98
5% increase in Electricity savings	53.81%	69.21	27.41%	3.01
5% decrease in Electricity savings	52.94%	67.84	27.36%	2.96

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

4.5 Procurement and implementation schedule

The installation of CNC benging machine can be done in the 10 – 14 days, However the CNC machine is end to end solution of CNC bending 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.	Activity	Weeks										
		1	2	3	4	5	6	7	8	9	10	11
1	Service Contract	■	■	■	■							
2	Civil Modification			■	■							
3	Commissioning					■	■					
4	Training						■	■	■			

5	Trail operation											

ANNEXURE

Annexure – 1: Energy audit reports used for establishing

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

Audit No. 1 **Energy Consumption Pattern of Existing Technology**

S. No.	Particular	Unit	Value
1	Specific Energy Consumption	kWh/Tonne	975
2	Average Energy Cost	`/Tonne	4875
3	Reduction in Rejection rate	`/tonne	13500
4	Other Cost (Man Power/Utility)	`/tonne	10000
5	Average Production cost	`/tonne	28375
6	Annual Production	Tonne	130.5
7	Annual Production Cost	`/annum	3702937.5

Energy savings estimation for CNC machine

S. No.	Particular	Unit	Conventional machines	CNC machines
1	Specific Energy Consumption	kWh/Tonne	975	663.4
2	Average Energy Cost	`/Tonne	4875	3317
3	Cost of Material Rejection	`/Tonne	13500	8115
4	Other Cost (Man Power/Utility)	`/tonne	10000	5528.6
5	Average Production	`/tonne	28375	16961
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/annum	3702937.5	2213358.3
8	Reduction in Production Cost	`/Tonne	11414	
9	Annual cost reduction	`/Annum	1489579.2	

S. No	Particular	Unit	Conventional Gear Hobbing machine	CNC Gear Hobbing machine
1	Annual Production	Tonne/annum	130.5	228.375
2	Annual Production Cost	`/annum	3702938	3873377
3	Reduction in Production Cost	`/Tonne	11414	
4	Annual cost reduction	`/Annum	2606764	

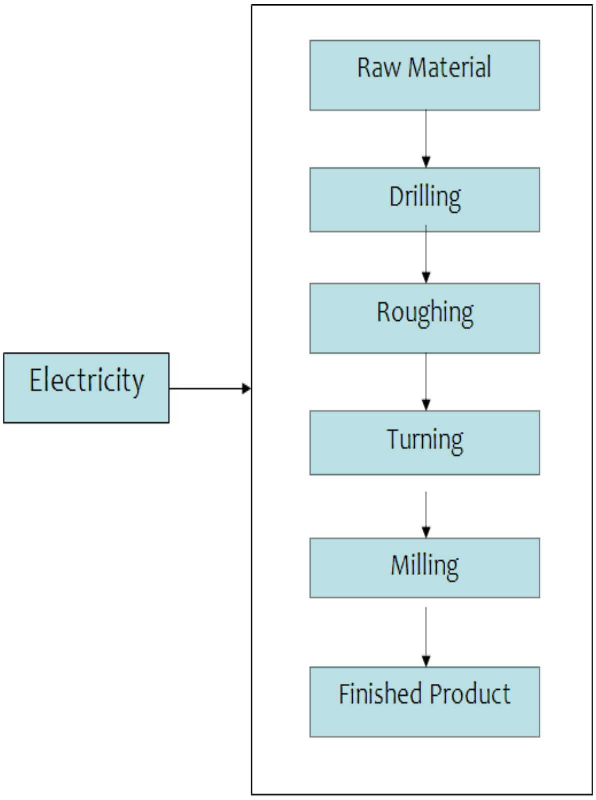
*****The savings are due to increased production and reduced production costs.***

- ✓ ***`11414*** Cost reduction per tonne
- ✓ ***228.375 tonne*** increased production

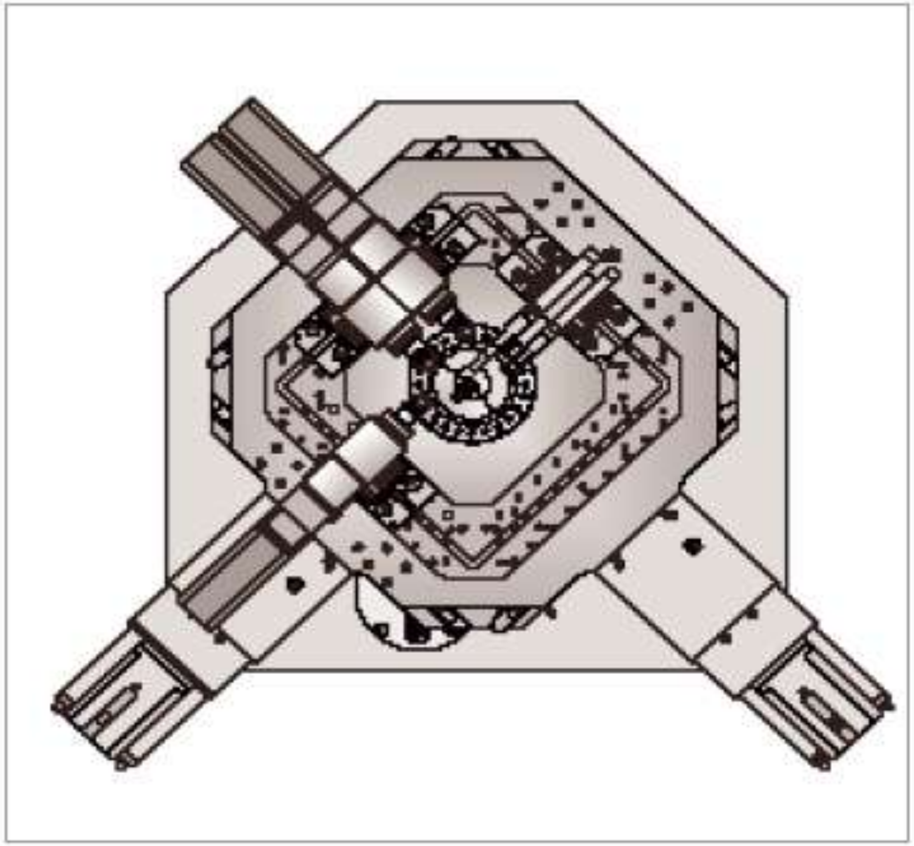
11414 x 228.375 = 2606764

Annexure 2: Process flow diagram

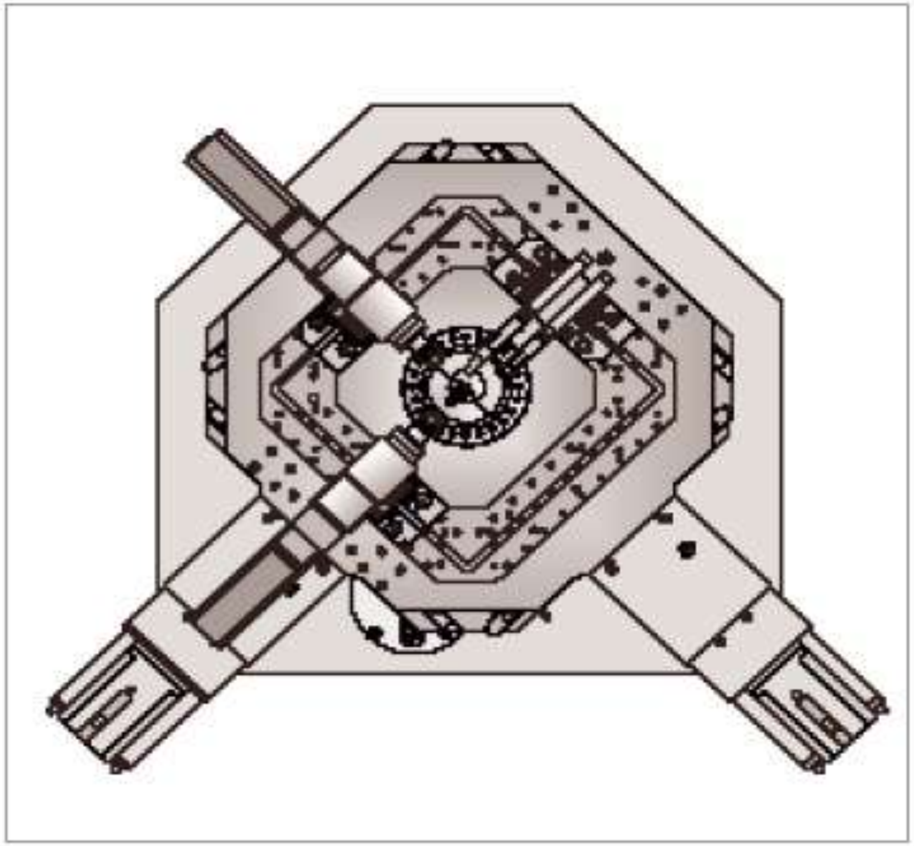
CNC bending machine is end to end solution for CNC machining process in machine tools manufacturing units. Lathe machine computerized numerical control (CNC) machines have become the application of choice for complex surface machining. These machine tools are widely used in the aerospace, automotive,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



Annexure 3: Technical Drawing of CNC Bending machine



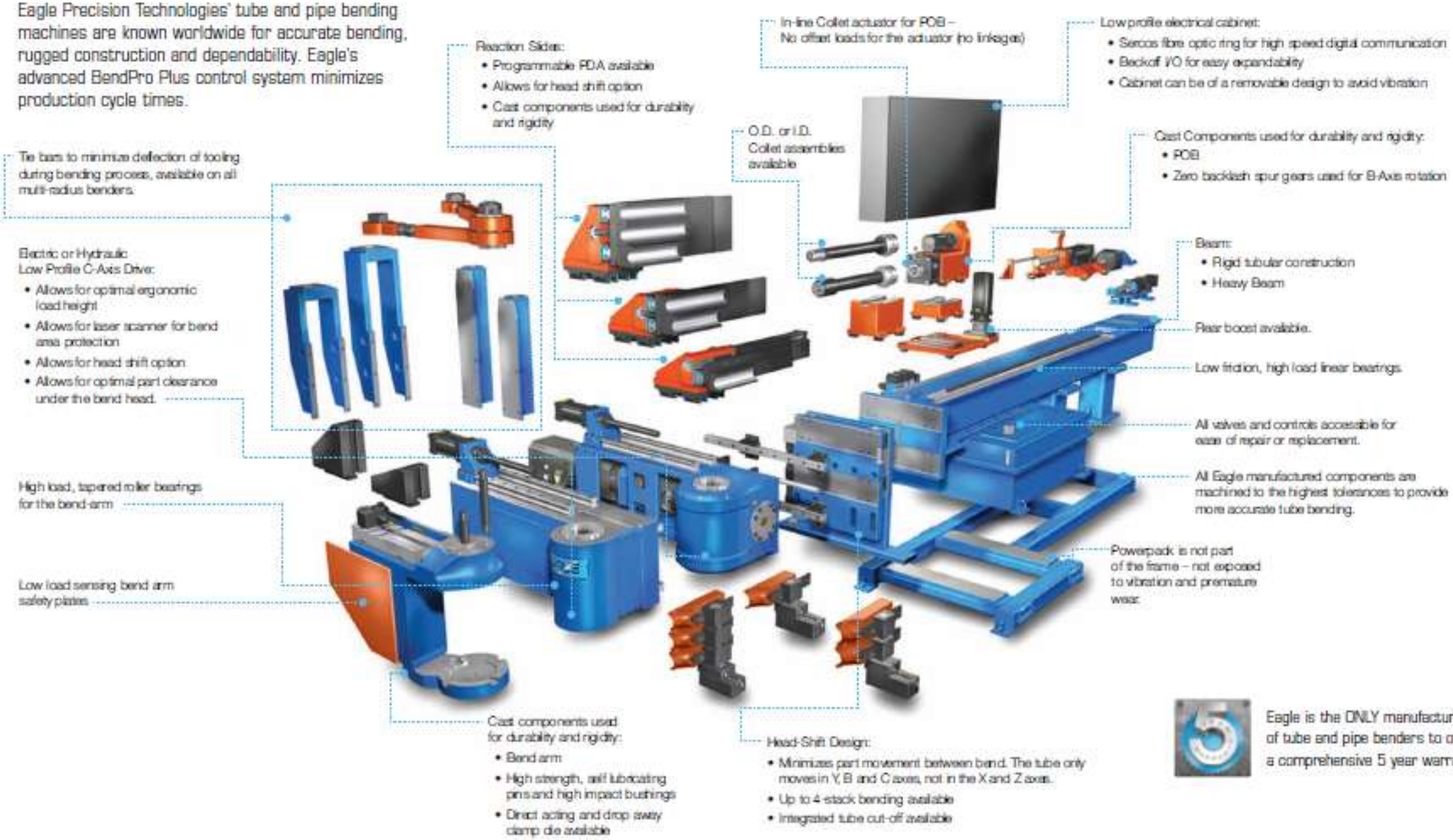
Basic machine with 6 CNC axes and 2 additional rotary units



Basic machine with 6 CNC axes plus 1 rotary unit with switch mandrel


File
View
Machine
Diagnostics
Utilities
Help
Recorded Teach Steps
EAGLE
Teachable Devices
Select Device
To Go
Target
Y (Carriage)
Add Hold
Jog Speed
Go Back
Done
Jog Back

Eagle Precision Technologies' tube and pipe bending machines are known worldwide for accurate bending, rugged construction and dependability. Eagle's advanced BendPro Plus control system minimizes production cycle times.



Eagle is the ONLY manufacturer of tube and pipe benders to offer a comprehensive 5 year warranty.

Annexure 4: Detailed financial calculations & analysis for financial indicators

Assumption

Name of the Technology	***CNC Bending 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)	34.35	Feasibility Study
Cost of modification in civil construction	` (in lakh)	1.20	Feasibility Study
Cost of consultancy	` (in lakh)	0.35	Feasibility Study
IDC	` (in lakh)	0.45	Feasibility Study
Total Investment	` (in lakh)	36.35	Feasibility Study
Financing pattern			
Own Funds (Equity)	` (in lakh)	9.09	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	27.26	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	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kW/Tonne	312	
Annual production	Tonne/Annum	228.375	
Cost	`/kWh	5	
Other savings	`/Annum	9856.4	
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	27.26	2.10	25.16	3.15
2	25.16	4.40	20.76	2.32
3	20.76	5.10	15.66	1.85
4	15.66	5.80	9.86	1.31
5	9.86	6.40	3.46	0.70
6	3.46	3.46	0.00	0.10
		27.26		

WDV Depreciation

Particulars / years	***1***	***2***	***3***	***4***	***5***
Plant and Machinery					
Cost	36.35	7.27			
Depreciation	29.08	5.82			
WDV	7.27	1.45			

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8
Revenue through Savings								
Total Revenue (A)	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07
Expenses								
O & M Expenses	1.82	1.91	2.00	2.10	2.21	2.32	2.44	2.56
Total Expenses (B)	1.82	1.91	2.00	2.10	2.21	2.32	2.44	2.56
PBDIT (A)-(B)	24.25	24.16	24.07	23.97	23.86	23.75	23.64	23.51
Interest	2.46	2.32	1.85	1.31	0.70	0.10	-	-
PBDT	21.80	21.84	22.22	22.66	23.16	23.65	23.64	23.51
Depreciation	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
PBT	19.88	19.92	20.30	20.74	21.24	21.73	21.72	21.60
Income tax	-	5.45	7.55	7.70	7.87	8.04	8.03	7.99
Profit after tax (PAT)	19.88	14.47	12.75	13.04	13.37	13.69	13.68	13.60

Computation of Tax `(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	19.88	19.92	20.30	20.74	21.24	21.73	21.72	21.60
Add: Book depreciation	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Less: WDV depreciation	29.08	5.82	-	-	-	-	-	-
Taxable profit	(7.29)	16.02	22.22	22.66	23.16	23.65	23.64	23.51
Income Tax	-	5.45	7.55	7.70	7.87	8.04	8.03	7.99

Projected Balance Sheet `(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09
Reserves & Surplus (E)	19.88	34.35	47.10	60.13	73.50	87.19	100.88	114.48
Term Loans (F)	25.16	20.76	15.66	9.86	3.46	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	54.13	64.20	71.85	79.09	86.06	96.29	109.97	123.57
Assets								
Gross Fixed Assets	36.35	36.35	36.35	36.35	36.35	36.35	36.35	36.35
Less: Accm. Depreciation	1.92	3.84	5.76	7.68	9.60	11.52	13.44	15.36
Net Fixed Assets	34.43	32.51	30.59	28.67	26.76	24.84	22.92	21.00
Cash & Bank Balance	19.70	31.69	41.26	50.41	59.30	71.45	87.05	102.58
Total Assets	54.13	64.20	71.85	79.09	86.06	96.29	109.97	123.57
Net Worth	28.96	43.44	56.18	69.22	82.59	96.28	109.97	123.57
Dept equity ratio	2.77	2.28	1.72	1.09	0.38	0.00	0.00	0.00

Projected Cash Flow: `(in lakh)

Particulars / Years	0	1	2	3	4	5	6	7	8
Sources									
Share Capital	9.09	-	-	-	-	-	-	-	-
Term Loan	27.26								
Profit After tax		19.88	14.47	12.75	13.04	13.37	13.69	13.68	13.60
Depreciation		1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Total Sources	36.35	21.80	16.39	14.67	14.96	15.29	15.61	15.60	15.52
Application									

Capital Expenditure	36.35								
Repayment of Loan	-	2.10	4.40	5.10	5.80	6.40	3.46	-	-
Total Application	36.35	2.10	4.40	5.10	5.80	6.40	3.46	-	-
Net Surplus	-	19.70	11.99	9.57	9.16	8.89	12.15	15.60	15.52
Add: Opening Balance	-	-	19.70	31.69	41.26	50.41	59.30	71.45	87.05
Closing Balance	-	19.70	31.69	41.26	50.41	59.30	71.45	87.05	102.58

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

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		19.88	14.47	12.75	13.04	13.37	13.69	13.68	13.60
Depreciation		1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Interest on Term Loan		2.46	2.32	1.85	1.31	0.70	0.10	-	-
Cash outflow	(36.35)	-	-	-	-	-	-	-	-
Salvage value									21.00
Net Cash flow	(36.35)	24.25	18.72	16.52	16.27	15.99	15.71	15.60	36.52
IRR	53.38%								
NPV	68.53								

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Operation & Maintenance Exp (75%)	1.36	1.43	1.50	1.58	1.66	1.74	1.83	1.92
Sub Total (G)	1.36	1.43	1.50	1.58	1.66	1.74	1.83	1.92
Fixed Expenses								
Operation & Maintenance Exp	0.45	0.48	0.50	0.53	0.55	0.58	0.61	0.64
Interest on Term Loan	2.46	2.32	1.85	1.31	0.70	0.10	0.00	0.00
Depreciation *(H)*	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Sub Total (I)	4.83	4.72	4.27	3.75	3.17	2.60	2.53	2.56
Sales (J)	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07
Contribution (K)	24.71	24.64	24.57	24.49	24.42	24.33	24.25	24.15
Break Even Point (L= G/I) (%)	19.56%	19.15%	17.39%	15.33%	13.00%	10.70%	10.43%	10.59%
Cash Break Even {(I)-(H)} (%)	11.79%	11.36%	9.58%	7.49%	5.14%	2.81%	2.51%	2.65%
Break Even Sales (J)*(L)	5.10	4.99	4.53	4.00	3.39	2.79	2.72	2.76

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	19.88	19.92	20.30	20.74	21.24	21.73	21.72	21.60	167.12
Net Worth	28.96	43.44	56.18	69.22	82.59	96.28	109.97	123.57	610.22
ROI	27.39 %								

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	19.88	14.47	12.75	13.04	13.37	13.69	13.68	13.60	87.19
Depreciation	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	11.52

Interest on Term Loan	2.46	2.32	1.85	1.31	0.70	0.10	0.00	0.00	8.75
Total (M)	24.25	18.72	16.52	16.27	15.99	15.71	15.60	15.52	107.46

Debt

Interest on Term Loan	2.46	2.32	1.85	1.31	0.70	0.10	0.00	0.00	8.75
Repayment of Term Loan	2.10	4.40	5.10	5.80	6.40	3.46	0.00	0.00	27.26
Total (N)	4.56	6.72	6.95	7.11	7.10	3.56	0.00	0.00	36.01
Average DSCR (M/N)	2.98								

Annexure 5: Details of procurement and implementation plan

S. No.	Activity	Weeks										
		1	2	3	4	5	6	7	8	9	10	11
1	Service Contract	■	■	■	■							
2	Civil Modification			■	■							
3	Commissioning					■	■					
4	Training						■	■	■			
5	Trail operation									■	■	■

Annexure 6: Details of technology/equipment and service providers

Name of Organization	Communication Address	Contact No.	E-mail
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
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	-
Mazak company,	Concord Towers, 14th Floor, UB City, Bangalore	Concord Towers, 14th Floor, UB City, Bangalore	-

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

Technical Specifications for CNC Bending Machine

Technical Data

Application	specification	Value
Press Capacity	400 KN	
Bending System	Hydraulic	
Hydraulic Pressure	300 bar	
Bending Accuracy	0.2°	
Workpieces	max. 200 x 20mm	7.87“ x 0.79“
Rapid Movement	50 mm/s	1.97“/s
Inching	10 mm/s	0.4“/s
Stroke	max. 200 mm	7.9“
Return Stroke	adjustable	
Working Height	975 mm	38.4“
Electrical Standards	according to VDE	
Electrical Connected Load	7.5 KW	
Side Stop	digital DC servomotor with reticulating ball screw	
Software	Power Bend	
Control Unit	industrial PC running Windows XP or higher	
Finishing	RAL 5010 Gentian Blue	
Doors and Coverings	RAL 7035 Light Grey	
Safety Installations	all danger zones are secured according to CE standards	

GMT ENGINEERS PVT LTD

R020-08/2011 August 12, 2011.

M/s. Petroleum Conservation Research Association,
(Under the Ministry of Petroleum & Natural Gas – Govt. of India)
" T.M.B. Mansion", 1st Floor, 739, Anna Salai, Chennai – 600 002.
Phone: 044 – 2841 8018 / 2852 0417. Fax: 044 – 2852 1662.
Mb: 09442630838.
Email : thangadurai@pcra.org / athangadurai1@gmail.com Web: www.pcra.org

Kind Attn.: Mr. A. Thangadurai. Deputy Director.

Dear Sirs,

On behalf of our Principals **M/s.JIANGSU YANGLI GROUP CO., LTD**, China, we take pleasure in submitting our **least and final offers** for supply of CNC Hydraulic Press Brake Machine.

SL.NO.	PARTICULARS	Qty	Price in US$
			FOB
1.	MB8 series CNC Hydraulic Press Brake Machine with distance between uprights 2500mm with Delem DA65 controller.		SHANGHAI
	MODEL : MB8 100X3200	One	55,500.00
			55,500.00

TERMS & CONDITIONS of M/s. JIANGSU YANGLI GROUP CO., LTD.

- Please note that the prices mentioned above are after deducting all Trade Discount applicable. Standard punch & die set will be supplied along with machine.
- Price: The price is firm and is on FOB SHANGHAI.
- Note: Prices are Exclusive of First Fill of Oil and Grease.
- Customs Duties and other levies involved in Import to be borne by you.
- Customs Clearing Charges, Insurance, Local Freight Chennai Port to your factory, Loading and Unloading charges at actuals extra to your a/c.
- The above cost does not include LC Opening charges & any other applicable charges between your Bankers & YANGLI's bankers.
- Payments: 100% IRREVOCABLE L/C AT SIGHT
- Despatch: 60 days from the date of receipt of your 100% atsight LC.
- Order in favor of: M/s.JIANGSU YANGLI GROUP CO., LTD
- The price is for Standard Specifications in case of Customer's special specification the price would be increased.
- Original Proforma Invoice for opening LC shall be forwarded M/s. JIANGSU YANGLI GROUP CO., LTD at the time of placement of orders.
- VALIDITY: 10 DAYS.

Yours faithfully,
for **GMT Engineers Pvt Ltd.**,

M. SANTHANA RAMAN,
Product Manager,
Mobile # 09003082277.

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Chennai – 600002

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