DETAILED PROJECT REPORT
ON
REPLACEMENT OF CONVENTIONAL WIRE CUT MACHINE WITH CNC WIRE CUT MACHINE (BANGALORE MACHINE TOOL CLUSTER)











Bureau of Energy Efficiency

Prepared By

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REPLACEMENT OF CONVENTIONAL WIRE CUT MACHINE WITH CNC WIRE CUT MACHINE OR NEW CNC WIRE CUT MACHINE

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

Detailed Project Report on Replacement of conventional Wire cut machine with CNC Wire cut Machine or New CNC Wire cut Machine

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 Report
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 recommendation made in the cluster manual is listed below:

Replacement of conventional Wire cut machine with CNC Wire cut Machine or new CNC Wire cut Machine

Wire EDM reduces or eliminates fixtures and tooling for one of a kind or low run production parts. Finishing is minimized and parts may be used immediately in assembly, minimizing the time between design and delivery Wire EDM, which can accurately machine as programmed, is very effective for directly cutting a small quantity of multiple parts from sheet metal stock. In particular, trial stamping of parts whose final shape is not yet determined becomes unnecessary. Very thin parts which are difficult to blank on a press can be readily obtained in quantities of over 10 to several hundred when stock sheets stacked together and clamped are machined by Wire EDM. Laminations for electric motors are easily produced from silicon steel in this fashion. *Exotic Materials* Wire EDM has an exceptional capability to machine exotic materials (Super alloys, Medical grade stainless, Titanium, Hastelloy®, Nimonics, Monels®, Inconels®, Tungsten carbide, Aluminum alloys, Copper, etc.). *Elimination of Stress and Distortion* Because hardened

materials can be wire cut, Wire EDM eliminates the need for post-machining heat-treating that can cause part distortion. Wire EDM is a completely submerged process and imposes very little heat stress on the work piece. *Burr-free, Superior Edge Finish* Wire EDM produced work pieces are accurate and burr-free, with excellent surface finish; ready for immediate use as finished parts. And under proper maintenance will serve the owner for a period of 15 to 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:

Sr. No.	***Particular***	***Unit***	***Value***
1.	Project cost	` (in lakh)	61.00
2.	Electricity saving	kWh	78061
3.	Monetary benefit	` (in lakh)	26.07
4.	Simple payback period	Year	2.34
5.	NPV	` (in lakh)	54.48
6.	IRR	%age	28.31
7.	ROI	%age	21.87
8.	DSCR	ratio	2.02
9.	CO2 reuction	Tonnes/annum	58
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
- 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.

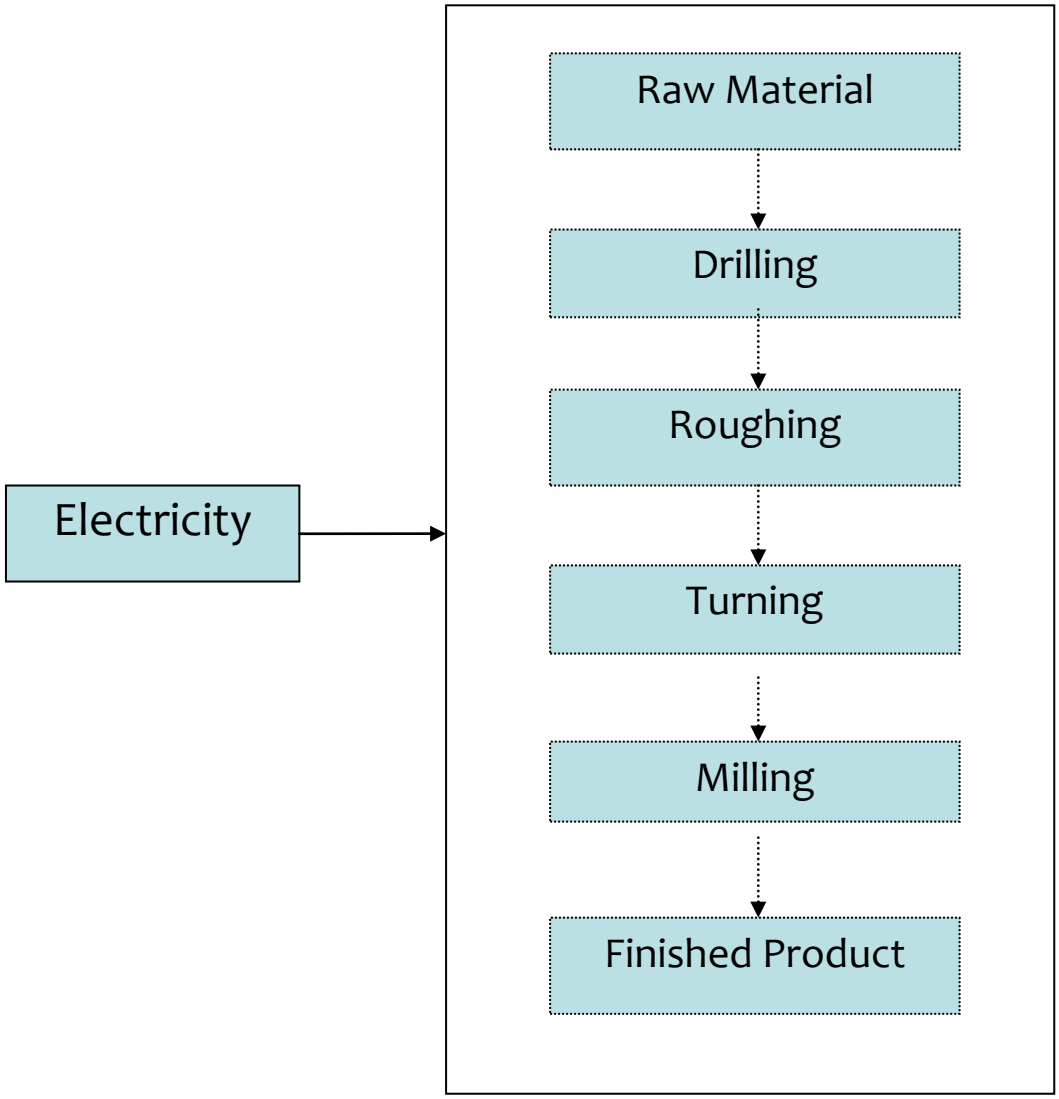
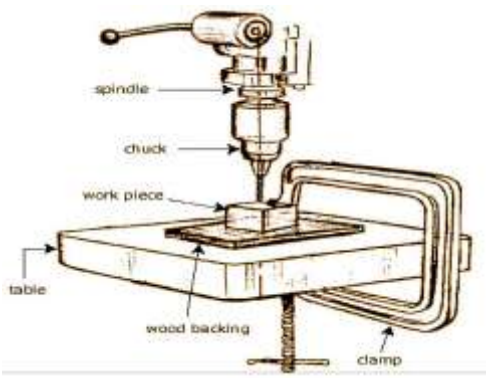


Figure 1.1 Process flow chart of typical Machine Tools Unit

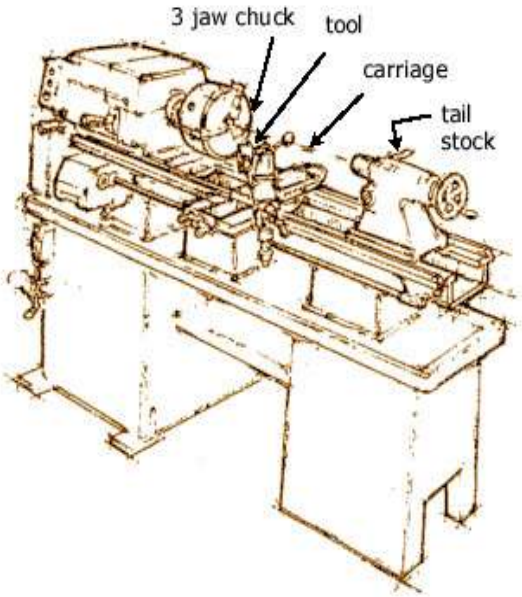
Drilling Process

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 holes 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.

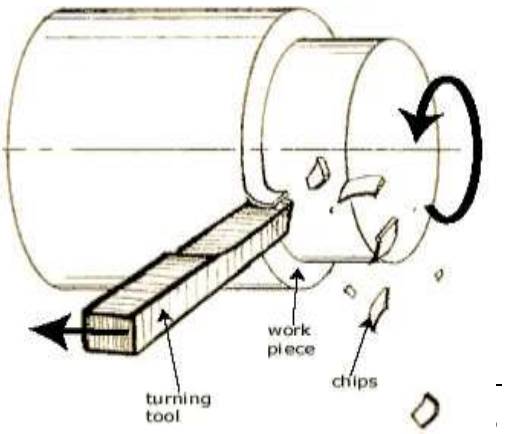
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

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 axis-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).

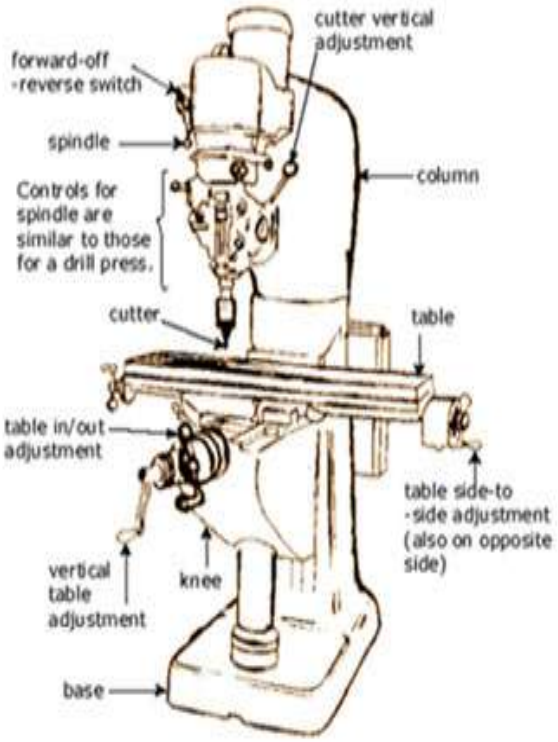
Non-specific operations include:

- ***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. Line boring (line boring, line-boring) implies the former. Back boring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

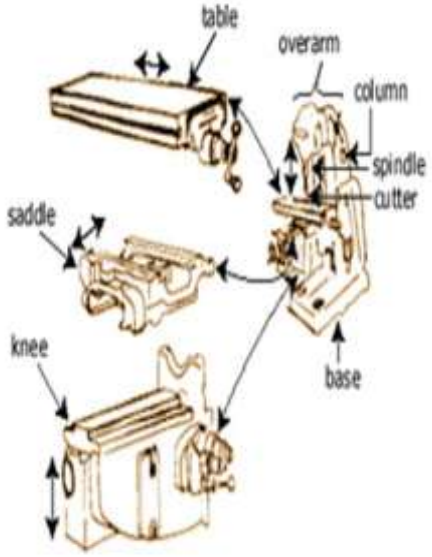


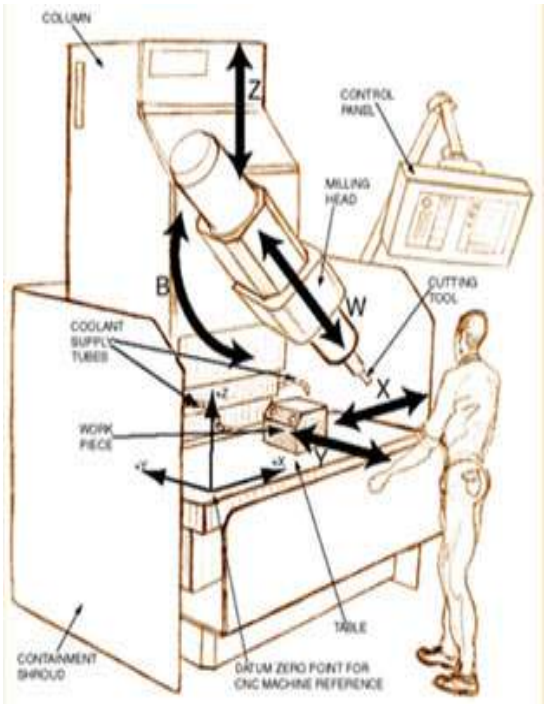
- ***Knurling***

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 fixture 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.

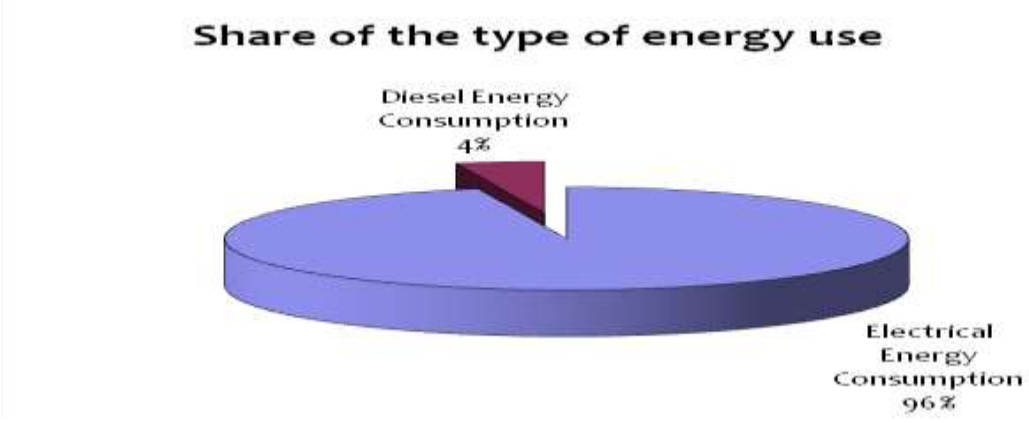


Figure 1.2: Share of Energy Type used in the Machine Tool Units

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

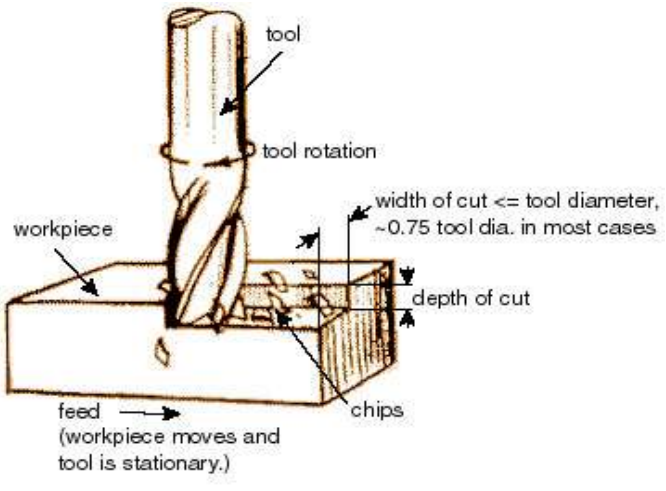
centers, lathes and automats, boring, milling, drilling, grinding, honing and polishing machines, total NC machines and so on. Metal forming machines include bending, folding, straightening, flattening machines, punching and/or shearing machines, die casting machines and others.

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 axes of a machine, monitoring of the controller and machine tools performance, and monitoring of the cutting process. For a basic three axes milling machine, with the CNC systems, there could be coordination of feeding velocity and position control of all the three axes. 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 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 depends on the cost of production of these units. It can be onserved that the total production cost is about ` 28374 per tonne and `3702814 annually.

Table 1.2 Energy Consumption Pattern of Existing Technology

Particular	*Unit*	*Value*
Specific Energy Consumption	kWh/Tonne	974.81
Average Energy Cost	`/Tonne	4874.05
Reduction in Rejection rate out of replacement by CNC machine/savings in Rs.	`,/tonne	13500
Other Cost (Man Power/Utility)	`/tonne	10000
Average Production cost	***`/tonne***	***28374.05***
Annual Production	Tonne	130.5
Annual Production Cost	`/annum	3702814

1.4.1 Design and operating parameters /specification

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

S. No.	Particulars	Value
1	Annual Electricity Consumption, kWh	1,27,212
2	Annual Fuel (HSD) consumption, Lt	0
3	Annual Energy Consumption, GJ	458.0
4	Total Annual production, Tonne	130.5
5	Average Specific Energy Consumption, GJ/T	3.5

Energy consumption Pattern of existing system on the basis of annual electricity usage

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 products, job properties, sourcing of raw materials, and variations in manufacturing and housekeeping operations. The overall step by step methodology followed for Energy use and technical study is as below:

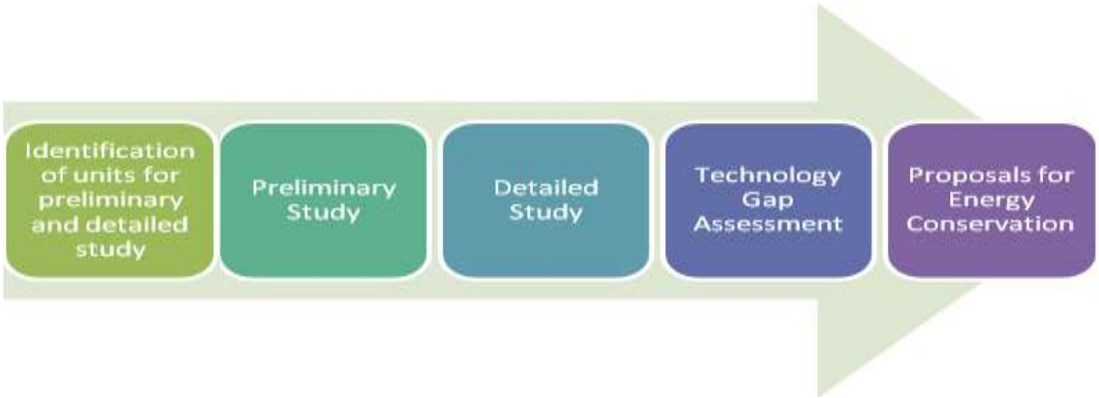


Figure 1.3 Energy auditing methodology

Preliminary energy study

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

Detailed energy study

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

1.4.3 Specific fuel and electricity consumption

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

1.5 Barriers for adoption of proposed technology/equipments

1.5.1 Technological Barrier

Technology obsolescence in the machine tool business is extremely rapid. Product lifecycles are declining and currently average life cycle is not 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 use 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 a company/CEO himself.

2 TECHNOLOGY OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology selected

2.1.1 Description of technology

Wire EDM (electrical discharge machining) is an exceptionally precise, efficient and economical manufacturing route in many applications, allowing customers to design parts for optimum function, without the many restrictions of other metalworking processes. Wire EDM produces exceptionally precise, parallel sidewalls, allowing stacking when machining multiple parts from sheet material. Taper cuts and free curves can be achieved simply. PRECISION MICRO offers the very latest in computer controlled Wire EDM, manufacturing to tolerances of ± 5 microns. The software is common to its milling and turning operations, enabling work pieces to be easily transferred between machines for multi-cavity work and high precision finishing.

Intricate Contour Capability Highly complex, contoured shapes can be produced, freeing designers to configure their requirements, in a single piece rather than several component parts. *Tight Tolerances* Because of the absence of machining forces, Wire EDM is capable of holding tight tolerances to ± 5 microns. Multiple Components. As Wire EDM cuts in an exceptionally straight, true and parallel manner, multiple parts can be produced through stacking sheet materials and cutting several components at the same time. Absolute Consistency Because there is no tooling to wear, Wire EDM offers superior consistency on every part manufactured in new modern manufacturing industry, machine has become more efficient, complicated and fully automated. This type of new generation machines only requires fewer man powers to operate because of automation functions. Thus this new feature is able to increase the volume of production but it requires new maintenance principles.

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

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

The widest range of ferrous and non-ferrous materials including hard metals and exotic alloys that is difficult or impossible to machine to such tolerances by other means Material thickness 0.1mm to 225mm, Minimum wire cutting diameter 0.1mm, Max weight of work piece 350kgs, Aperture walls created by Wire ED Mare parallel, unlike those cut by laser or water jet Accuracy +/- 5 microns Surface finish depends on number of passes and machining speed.

2.1.2 CNC Wire Cut Machine operations

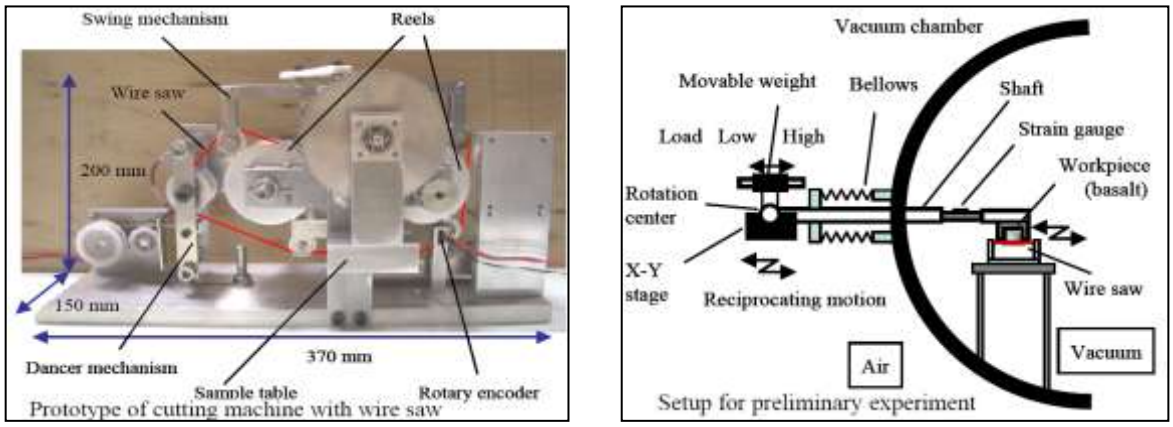
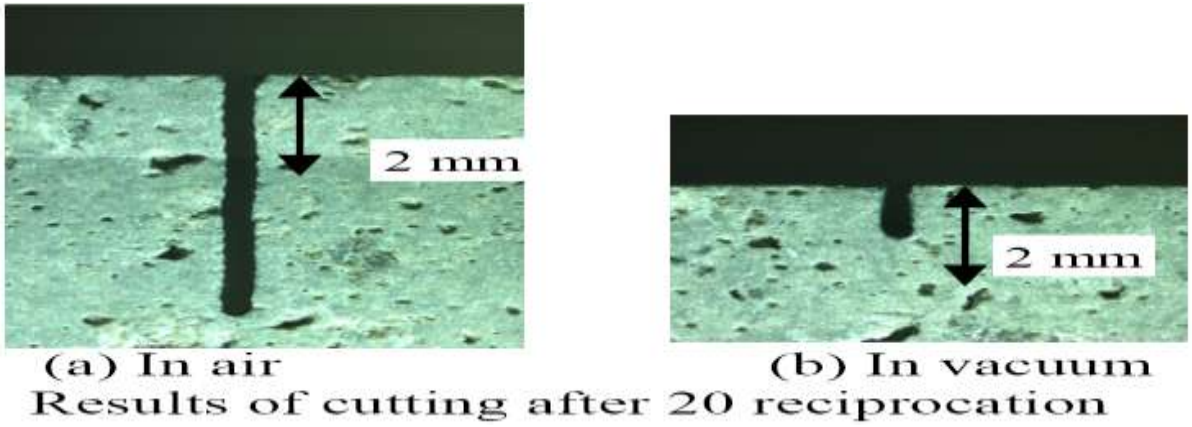


Figure 2.1 CNC Wire Cut Machine operations

Machining of Stamping and Press Tool Precision Engineering Cutting die, punches, stripper plate, punch plate and other die components can be accurately machined. Since the process of Wire EDM readily performs highly accurate machining, It is an established major method of machining press forming dies. The 1-micron per pulse positioning function of Wire EDM can easily locate the wire electrode within a 0.005-mm tolerance of the desired position. This feature of Wire EDM can be very useful for Progressive Tools, which require close pitch tolerance. Fixture for PVD Sputtering… Electronics An electronics device manufacturer required a micro component with a selective controlled coating of ruthenium (a rare member of the platinum group of metals known for its conductivity and hardness properties). The coater require a fixture to hold the components

in position and mask the areas not requiring coating through an in-depth knowledge of the component and its specific geometries, PRECISION MICRO was able to design and manufacture such a fixture to extremely tight tolerances by using high precision Wire EDM preceded by initial feature machining on a CNC milling machine. Because both machines utilize the same control software, post alignment is easy and the multi cavity EDM machining can be carried out efficiently thanks to an automatic wire threading facility.

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



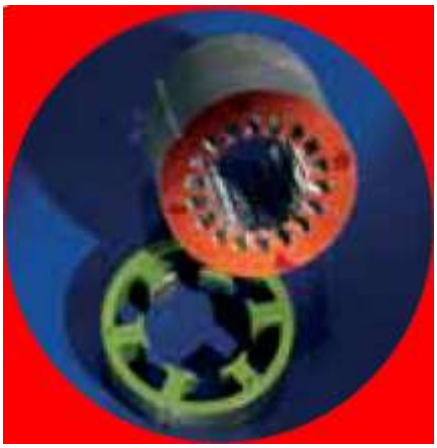
2.1.3 Technology specification

Table 2.1 Equipment Speciation

Specification CNC WIRE CUT Machines	
Applications	**Properties**
Tension:	12V - 24W
Length of the hot wire:	150 mm
PS-3629	Filicut only
PYRO-R200 Transformer	230/9-12V 20/100e
Fil-3631	Tube of 10 hot wires
Time to heat:	6 to 8 seconds
Power:	230V - 60W
Heating temperature:	600°C
Length of the blades:	according to the blade
HSG 0 Machine	only 230V
Blade R	Blade length 29 mm

Blade HS-SG	Curved blade
Specification CNC WIRE CUT Machines	
Support SF	Cutter foot
Dimensions	370×150×200 mm
Weight	5.3 kg
Maximum wire length	800 m
Maximum wire speed	2 m/s
Applications	Properties
Materials of structure	A2052, SUS304
Environment	Air, vacuum
Workpiece Basalt,	10 mm in width
Wire saw	φ0.2 mm-core,
	30-40 μm diamond
Wire speed	1 m/s
Reciprocating length	7 m
Number of reciprocation	5, 10, 20
Cutting load	2 N
Tension of wire saw	2 N

2.1.4 SUITABILITY OR INTEGRATION WITH EXISTING PROCESS



Wire EDM, which can accurately machine as programmed, is very effective for directly cutting a small quantity of multiple parts from sheet metal stock. In particular, trial stamping of parts whose final shape is not yet determined becomes unnecessary. Very thin parts which are difficult to blank on a press can be readily obtained in quantities of over 10 to several hundred when stock sheets stacked together and clamped are machined by Wire EDM. Laminations for electric motors are easily produced from silicon steel in this fashion Cutting die, punches, stripper plate, punch plate and other die components can be accurately machined. Since the process of Wire EDM readily performs highly accurate machining, it is an established major method of machining press forming dies.

The 1-micron per pulse positioning function of Wire EDM can easily locate the wire electrode within a 0.005-mm tolerance of the desired position. This feature of Wire EDM can very useful for Progressive Tools, which require close pitch tolerance. An electronics device manufacturer required a micro component with a selective controlled coating of ruthenium (a rare member of the platinum group of metals known for its conductivity and hardness properties). The coater required a fixture to hold the components in

position and mask the areas not requiring coating through an in-depth knowledge of the component and its specific geometries, precision micro was able to design and manufacture such a fixture to extremely tight tolerances by using high precision Wire EDM preceded by initial feature machining on a CNC milling machine. Because both machines utilizes the same control software, post alignment is easy and the multi cavity EDM machining can be carried out efficiently thanks to an automatic wire threading facility.

2.1.5 SUPERIORITY OVER EXISTING TECHNOLOGY

The CNC machines features a control panel that permits the lathe to be operated manually. This panel includes a multiple-line LCD display, an easy-to-use membrane keypad, an error indicator/pause button, and a key-released emergency stop push-button. The lathe parameters, including the spindle speed, the feed rate, the reference point, and the X and Z axes coordinates of the cutting tool are adjusted by accessing different menus. During the turning, the control panel displays the X and Z axes coordinates of the cutting tool, the feed rate, and the spindle speed.

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

- The widest range of ferrous and non-ferrous materials including hard metals and exotic alloys that are difficult or impossible to machine to such tolerances by other means
- Material thickness 0.1mm to 225mm
- Minimum wire cutting diameter 0.1mm
- Max weight of work piece 350kgs
- Aperture walls created by Wire EDM are parallel, unlike those cut by laser or water jet
- Accuracy +/- 5 microns
- Surface finish depends on number of passes and machining speed
- Equipped with a choice of a state-of-the-art controller like this FANUC CNC controller.

2.1.6 Availability of technology

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

2.1.7 Source of technology

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

2.1.8 Service/technology providers

There are about 5 technology providers 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. 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 WIRE Cut machines can be done in the 5 days, However the CNC WIRE Cut machine is end to end solution of machining production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

2.2 Life cycle assessment and risks analysis

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

2.3 Suitable unit/plant for implementation of proposed technology

CNC WIRE Cut machine is suitable for the units involved in the production of more fast production than conventional machines hence 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 WIRE Cut Machines are rapidly replacing the older production cutting 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 turn out parts under the occasional supervision of an operator. The machine is controlled electronically via a computer menu style interface, the program may be modified and displayed at the machine, along with a simulated view of the process. The setter/ operator needs high level of skill to perform the process, however the knowledge base is broader compared to the older production machines where intimate knowledge of each machine was considered essential. These machines are often set and operated by the same person, where the operator will supervise a small number of machines (cell). And saving capacity of the producting unit is enhanced without effecting the annual production of the unit.

The design of a CNC WIRE Cut Machines has evolved yet again however, the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed. The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues. Installation of CNC WIRE Cut machine is the ability to machine complex shapes in a single setup. This reduces the machinist setup time and incerease the production rate. The main advantage of CNC WIRE Cutting process is ability to save time by cutting complex shapes in a single set-up. Additional benefit comes from allowing the use of shorter cutters that permits more accurate machining.

A CNC wirecut 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 wirecut machine revels that the CNC wirecut machine may produce two times cutting material at same time and at same energy consumption. The CNC wirecut machines gives us the annual savings of `14.9 lakh and of `11413.8 per Tonne produced.Energy & Cost saving including the energy, material rejection, man power cost and utility cost for a typical unit by installation of CNC WIRE Cut machine are tabulated below:

Table 3.1 Energy savings estimation for CNC Wirecut machine

Sr. No.	*Particular*	*Unit*	*Conventional* WIRE Cut *machines*	*CNC* WIRE Cut *machines*
1	Specific Energy Consumption	kWh/Tonne	974.81	633
2	Average Energy Cost	`/Tonne	4874.05	3165
3	Cost of Material Rejection	`,/Tonne	13500	7135
4	Other Cost (Man Power/Utility)	`./tonne	10000	6660.26
5	***Average Production***	***'/tonne***	***28374.1***	***16960.26***
6	Annual Production	Ton/annum	130.5	130.5
7	Annual Production Cost	`/annum	3702814	2213313.9
8	Reduction in Production Cost	`/Tonne		11413.79
9	Annual cost reduction	`/Annum		1489500

***Note:-** *As in the proposed DPR CNC Wire cut Machine is replaced by Conventional Wire cut 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 WIRE Cut machine is presently one of the most versatile machine tools available and they are becoming increasingly common. This cutting not only improve the quality of the product which is totaly designed by CNC WIRE Cut machine with comparision to the exisitng manual set up based product. The rejection of material in CNC WIRE Cutting 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 CNC WIRE Cut 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 Conventional WIRE Cut machines revels that the CNC WIRE Cut 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 WIRE Cutting 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 WIRE Cut machine will result in reduction of the utility system like compressed air system to operate the numetic system and other general utility expanses due to fast rate of the production with comparision to the existing technology. Some of them are listed below:-

3.2 Monetary benefits

Monetary savings in a typical unit after installation of CNC WIRE Cut machine has been estimated around `11413 per tonne and `26.07 lakh per annum. This figure has been arrived based on the annual reduction in energy, rate of material rejection and manpower cost savings in a typical unit multiplied by average annual production of the unit.

3.3 Social benefits

3.3.1 Improvement in working environment

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

3.3.2 Improvement in skill

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

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

As the existing and proposed technology is based on the low energy conservation and maximum output with saving of fuel and eletricity, hence 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 58.5 tonne of CO_2 per annum.

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 CNC wirecut machine are provided in Table 4.1 below:

Table 4.1 Cost of equipment

S. No.	Particulars	Cost
1	Cost of CNC WIRE cut machine	` 6,000,000

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

Sr. NO.	Particulars	Cost
1.	Cost of civil work	` 55,000/-
2.	Electrical & Utility Expanses	` 25,000/-
3.	Cost of Consultancy and installation	` 20,000/-
Total	Rupees One Hundred thousand only/-	` 100,000/-

Total investment in the proposed technology (including equipment cost & other cost) is ` 61.00 lakh.

4.2 Arrangements of funds

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

4.3 Financial indicators

4.3.1 Cash flow analysis

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

4.3.2 Simple payback period

The estimated payback period is about 2.34 years.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 54.48 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 28.31%. 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 21.87 %.

Table 4.4 Financial indicator of proposed technology

Particulars	*Unit*	*Value*
Simple Pay Back period	Years	2.34
IRR	%age	28.31
NPV	` in lakh	54.48
ROI	%age	21.87
DSCR	ratio	2.02

4.4 Sensitivity analysis

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

- Fuel saving increase by 5%
- Fuel saving decrease by 5%

Table 4.5: Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	28.31%	54.48	21.87%	2.02
5% increase in fuel savings	30.18%	60.17	22.07%	2.13
5% decrease in fuel savings	26.43%	48.79	21.63%	1.91

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

4.5 Procurement and implementation schedule

Total time period required for implementaton of proposed machine willl be 11 weeks.The installation of *CNC WIRE cut* machine can be done in the 7 - 15 days, However the CNC wirecut machine is end to end solution of CNC wirecut machineing cutting production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

ANNEXURE

Annexure 1: Energy audit reports used for establishing

The results of detail energy audit for M/s Sadbhava Fabricators private limited Bangalore Machine tool cluster production units with specefic energy consuption are given below:

Audit No. 1 Energy Consumption Pattern of Existing Technology

Particular	*Unit*	*Value*
Specific Energy Consumption	kWh/Tonne	974.81
Average Energy Cost	`/Tonne	4874.05
Reduction in Rejection rate out of replacement by CNC machine/savings in Rs.	`/tonne	13500
Other Cost (Man Power/Utility)	`./tonne	10000
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Annual Production	Tonne	130.5
Annual Production Cost	`/annum	3702814

Energy savings estimation for CNC Wirecut maching machine

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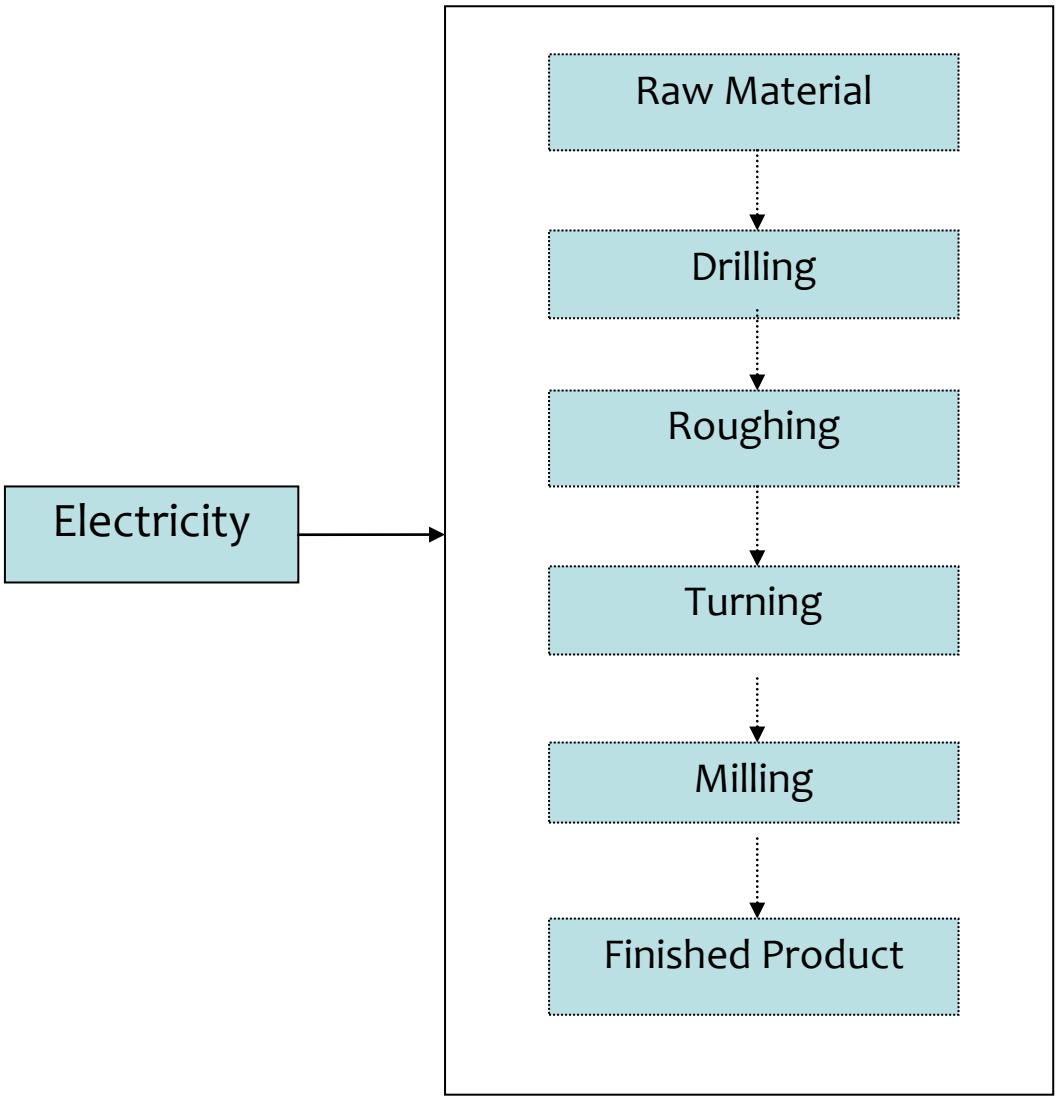
4	Other Cost (Man Power/Utility)	`/Tonne	10000	6660.26
5	Average Production	`./Tonne	28374.1	16960.26
6	Annual Production	Ton/annum	130.5	130.5
7	Annual Production Cost	`/annum	3702814	2213313.9
8	Reduction in Production Cost	`/Tonne		11413.79
9	Annual cost reduction	`./Annum		1489500

***Note:-** *As in the proposed DPR CNC Wire cut Machine is replaced by Conventional Wire cut 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 %.*

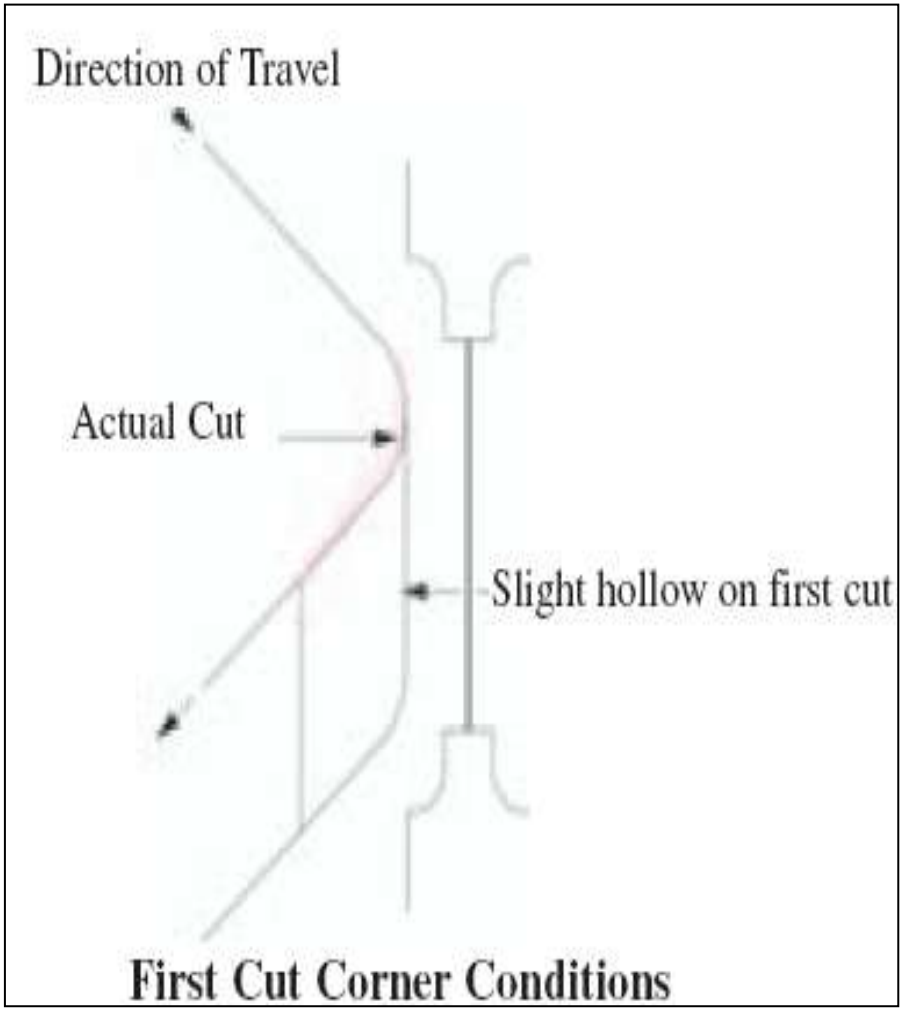
Sr. No.	Particular	Unit	Conventional WIRE Cut machines	CNC WIRE Cut machines
1	Average Production	`./Tonne	28374.1	16960.26
2	Annual Production	Ton/annum	130.5	228.4
3	Annual Production Cost	`/annum	3702814	3873723.38
4	Annual cost reduction	`./Annum		2606958

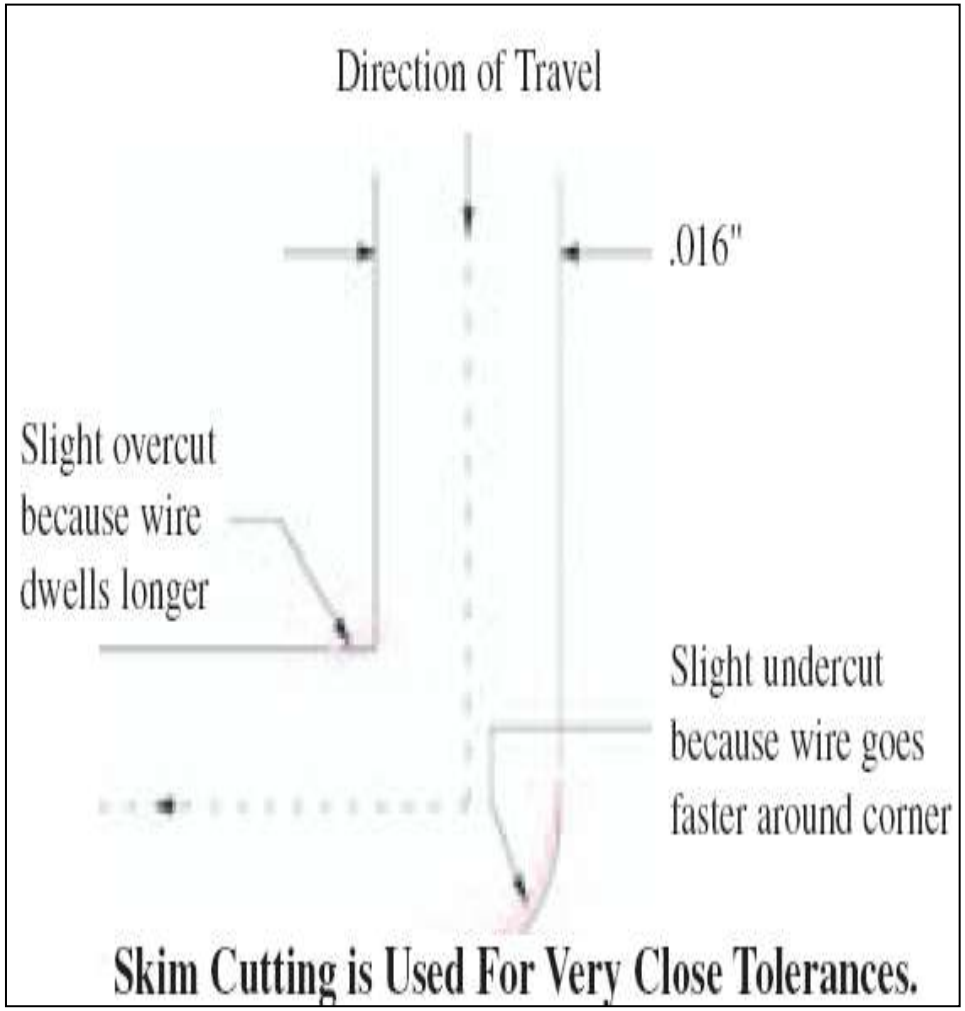
And the Final saving will be about `2606958 (`11414*228.4 tonne).

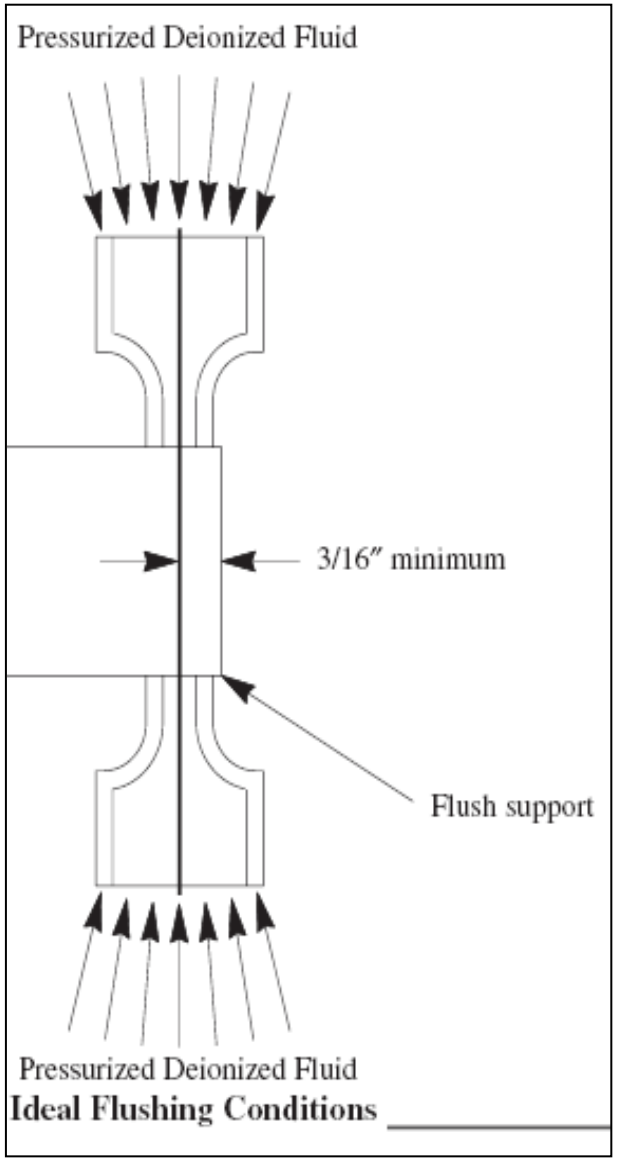
Annexure 2: Process flow diagram

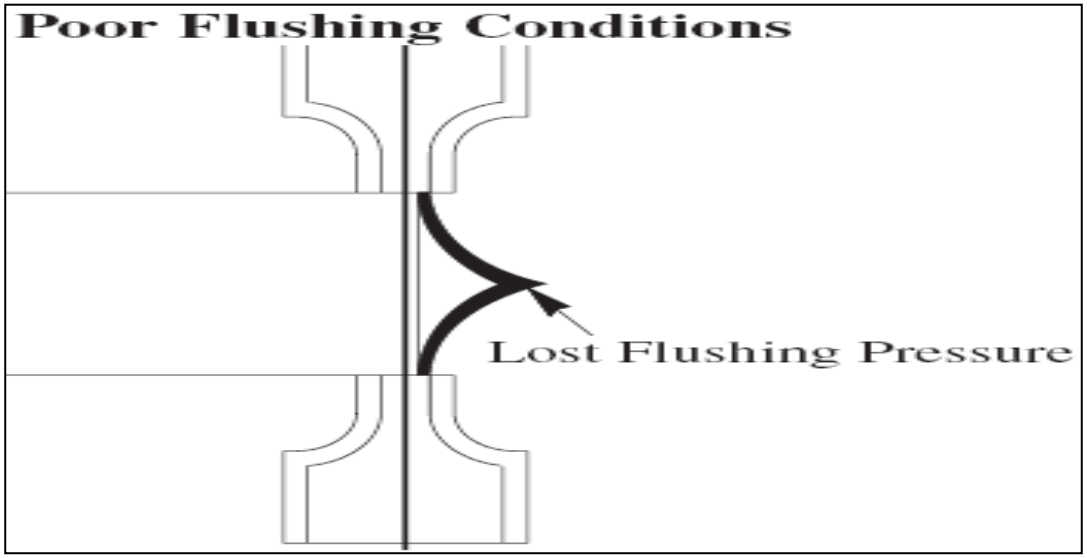


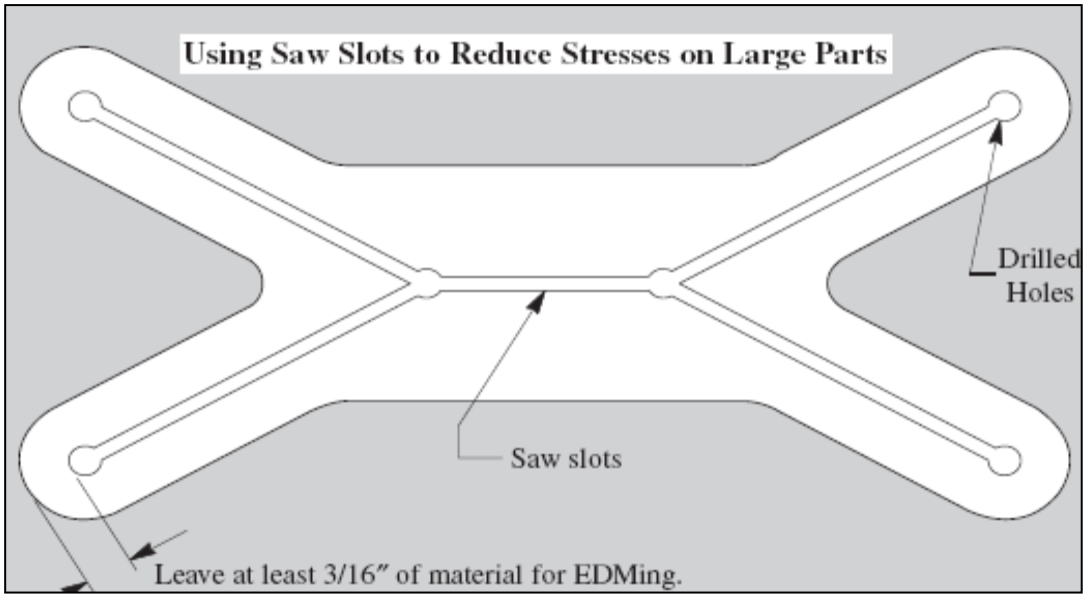
Annexure 3: Technical Drawing of CNC lathe machine

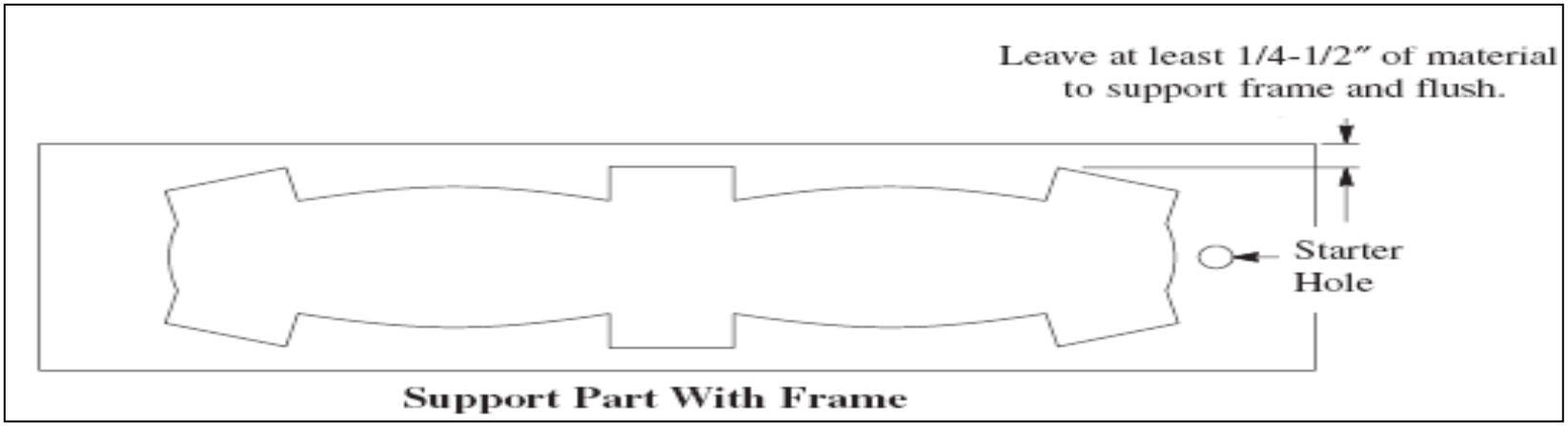




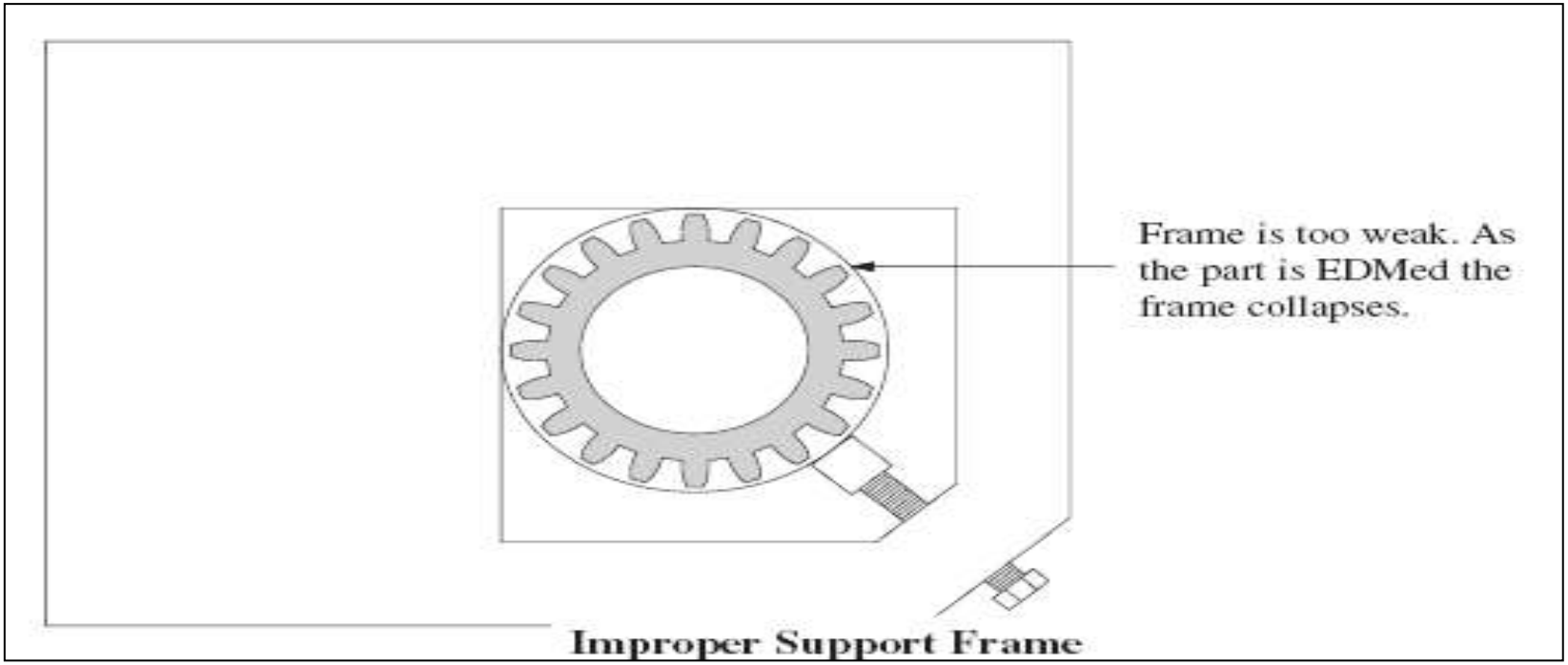

Pressurized Deionized Fluid
3/16″ minimum
Flush support
Pressurized Deionized Fluid
Ideal Flushing Conditions


Poor Flushing Conditions
Lost Flushing Pressure


Using Saw Slots to Reduce Stresses on Large Parts
Drilled Holes
Saw slots
Leave at least 3/16″ of material for EDMing.



Support Part With Frame



Improper Support Frame

Annexure 4: Detailed financial calculations & analysis for financial indicators

Assumption

Name of the Technology	CNC Wire cut 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)	60.00	Feasibility Study
Cost of modification in civil construction	` (in lakh)	0.55	Feasibility Study
Electrical & Utility expenses	` (in lakh)	0.25	
Cost of consultancy	` (in lakh)	0.20	Feasibility Study
Total Investment	` (in lakh)	61.00	Feasibility Study
Financing pattern			
Own Funds (Equity)	` (in lakh)	15.25	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	45.75	Feasibility Study
Loan Tenure	years	7	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	90	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kWh/Tonne	584.886	
Annual Production	Tonne/Annum	228.375	
Cost	`/kWh	5.00	
Other saving	`/Tonne	8489.36	
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	45.75	2.40	43.35	5.30
2	43.35	5.00	38.35	4.11
3	38.35	5.60	32.75	3.59
4	32.75	6.00	26.75	3.00
5	26.75	6.60	20.15	2.38
6	20.15	7.40	12.75	1.68
7	12.75	7.90	4.85	0.92
8	4.85	4.85	0.00	0.14
		45.75		

WDV Depreciation

Particulars / years	1	2
Plant and Machinery		
Cost	61.00	12.20
Depreciation	48.80	9.76
WDV	12.20	2.44

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Revenue through Savings										
Total Revenue (A)	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07
Expenses										
O & M Expenses	3.05	3.20	3.36	3.53	3.71	3.89	4.09	4.29	4.51	4.73
Total Expenses (B)	3.05	3.20	3.36	3.53	3.71	3.89	4.09	4.29	4.51	4.73
PBDIT (A)-(B)	23.02	22.86	22.70	22.54	22.36	22.17	21.98	21.77	21.56	21.33
Interest	5.30	4.11	3.59	3.00	2.38	1.68	0.92	0.14	-	-
PBDT	17.71	18.75	19.12	19.53	19.98	20.49	21.06	21.63	21.56	21.33
Depreciation	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
PBT	14.49	15.53	15.90	16.31	16.76	17.27	17.84	18.41	18.34	18.11
Income tax	-	3.06	6.50	6.64	6.79	6.96	7.16	7.35	7.33	7.25
Profit after tax (PAT)	14.49	12.47	9.40	9.67	9.97	10.30	10.68	11.06	11.01	10.86

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

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Profit before tax	14.49	15.53	15.90	16.31	16.76	17.27	17.84	18.41	18.34	18.11
Add: Book depreciation	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
Less: WDV depreciation	48.80	9.76	-	-	-	-	-	-	-	-
Taxable profit	(31.09)	8.99	19.12	19.53	19.98	20.49	21.06	21.63	21.56	21.33
Income Tax	-	3.06	6.50	6.64	6.79	6.96	7.16	7.35	7.33	7.25

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

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Liabilities										
Share Capital (D)	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25	15.25
Reserves & Surplus (E)	14.49	26.97	36.36	46.04	56.01	66.31	76.99	88.05	99.06	109.92
Term Loans (F)	43.35	38.35	32.75	26.75	20.15	12.75	4.85	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	73.09	80.57	84.36	88.04	91.41	94.31	97.09	103.30	114.31	125.17
Assets										
Gross Fixed Assets	61.00	61.00	61.00	61.00	61.00	61.00	61.00	61.00	61.00	61.00
Less: Accm. Depreciation	3.22	6.44	9.66	12.88	16.10	19.32	22.55	25.77	28.99	32.21
Net Fixed Assets	57.78	54.56	51.34	48.12	44.90	41.68	38.45	35.23	32.01	28.79
Cash & Bank Balance	15.31	26.01	33.03	39.92	46.51	52.63	58.64	68.06	82.30	96.38
Total Assets	73.09	80.57	84.36	88.04	91.41	94.31	97.09	103.30	114.31	125.17
Net Worth	29.74	42.22	51.61	61.29	71.26	81.56	92.24	103.30	114.31	125.17
Dept equity ratio	2.84	2.51	2.15	1.75	1.32	0.84	0.32	0.00	0.00	0.00

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

Particulars / Years	0	1	2	3	4	5	6	7	8	9	10
Sources											
Share Capital	15.25	-	-	-	-	-	-	-	-	-	-
Term Loan	45.75										
Profit After tax		14.49	12.47	9.40	9.67	9.97	10.30	10.68	11.06	11.01	10.86
Depreciation		3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
Total Sources	61.00	17.71	15.69	12.62	12.89	13.19	13.52	13.90	14.28	14.23	14.08
Application											
Capital Expenditure	61.00										
Repayment of Loan	-	2.40	5.00	5.60	6.00	6.60	7.40	7.90	4.85	-	-
Total Application	61.00	2.40	5.00	5.60	6.00	6.60	7.40	7.90	4.85	-	-

Net Surplus	-	15.31	10.69	7.02	6.89	6.59	6.12	6.00	9.43	14.23	14.08
Add: Opening Balance	-	-	15.31	26.01	33.03	39.92	46.51	52.63	58.64	68.06	82.30
Closing Balance	-	15.31	26.01	33.03	39.92	46.51	52.63	58.64	68.06	82.30	96.38

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

Particulars / months	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Profit after Tax		14.49	12.47	9.40	9.67	9.97	10.30	10.68	11.06	11.01	10.86
Depreciation		3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
Interest on Term Loan		5.30	4.11	3.59	3.00	2.38	1.68	0.92	0.14	-	-
Cash outflow	(61.00)	-	-	-	-	-	-	-	-	-	-
Salvage value											28.79
Net Cash flow	(61.00)	23.02	19.81	16.21	15.90	15.57	15.21	14.82	14.42	14.23	42.88
IRR	28.31%										
NPV	54.48										

Bre*ak Even Point* ***`(in lakh)***

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Variable Expenses										
Operation & Maintenance Exp (75%)	2.29	2.40	2.52	2.65	2.78	2.92	3.07	3.22	3.38	3.55
Sub Total (G)	2.29	2.40	2.52	2.65	2.78	2.92	3.07	3.22	3.38	3.55
Fixed Expenses										
Operation & Maintenance Exp (25%)	0.76	0.80	0.84	0.88	0.93	0.97	1.02	1.07	1.13	1.18
Interest on Term Loan	5.30	4.11	3.59	3.00	2.38	1.68	0.92	0.14	0.00	0.00
Depreciation (H)	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
Sub Total (I)	9.29	8.14	7.65	7.11	6.53	5.88	5.16	4.44	4.35	4.40
Sales (J)	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07	26.07
Contribution (K)	23.78	23.66	23.54	23.42	23.29	23.15	23.00	22.85	22.69	22.52
Break Even Point (L= G/I) (%)	39.05%	34.38%	32.48%	30.34%	28.03%	25.40%	2.44%	9.42%	19.16%	19.56%
Cash Break Even {(I)-(H)} (%)	25.51%	20.77%	18.80%	16.59%	14.20%	11.48%	8.44%	5.32%	4.97%	5.25%
Break Even Sales (J)*(L)	10.18	8.96	8.47	7.91	7.31	6.62	5.85	5.06	4.99	5.10

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

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Net Profit Before Taxes	14.49	15.53	15.90	16.31	16.76	17.27	17.84	18.41	18.34	18.11	168.96
Net Worth	29.74	42.22	51.61	61.29	71.26	81.56	92.24	103.30	114.31	125.17	772.69
ROI											21.87%

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

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cash Inflow										
Profit after Tax	14.49	12.47	9.40	9.67	9.97	10.30	10.68	11.06	11.01	10.86
Depreciation	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.22
Interest on Term Loan	5.30	4.11	3.59	3.00	2.38	1.68	0.92	0.14	0.00	0.00
Total (M)	23.02	19.81	16.21	15.90	15.57	15.21	14.82	14.42	14.23	14.08

Debt

Interest on Term Loan	5.30	4.11	3.59	3.00	2.38	1.68	0.92	0.14	0.00	0.00
Repayment of Term Loan	2.40	5.00	5.60	6.00	6.60	7.40	7.90	4.85	0.00	0.00
Total (N)	7.70	9.11	9.19	9.00	8.98	9.08	8.82	4.99	0.00	0.00
Average DSCR (M/N)	2.02									

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

Annexure 5: Details of procurement and implementation plan

S. No.	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											

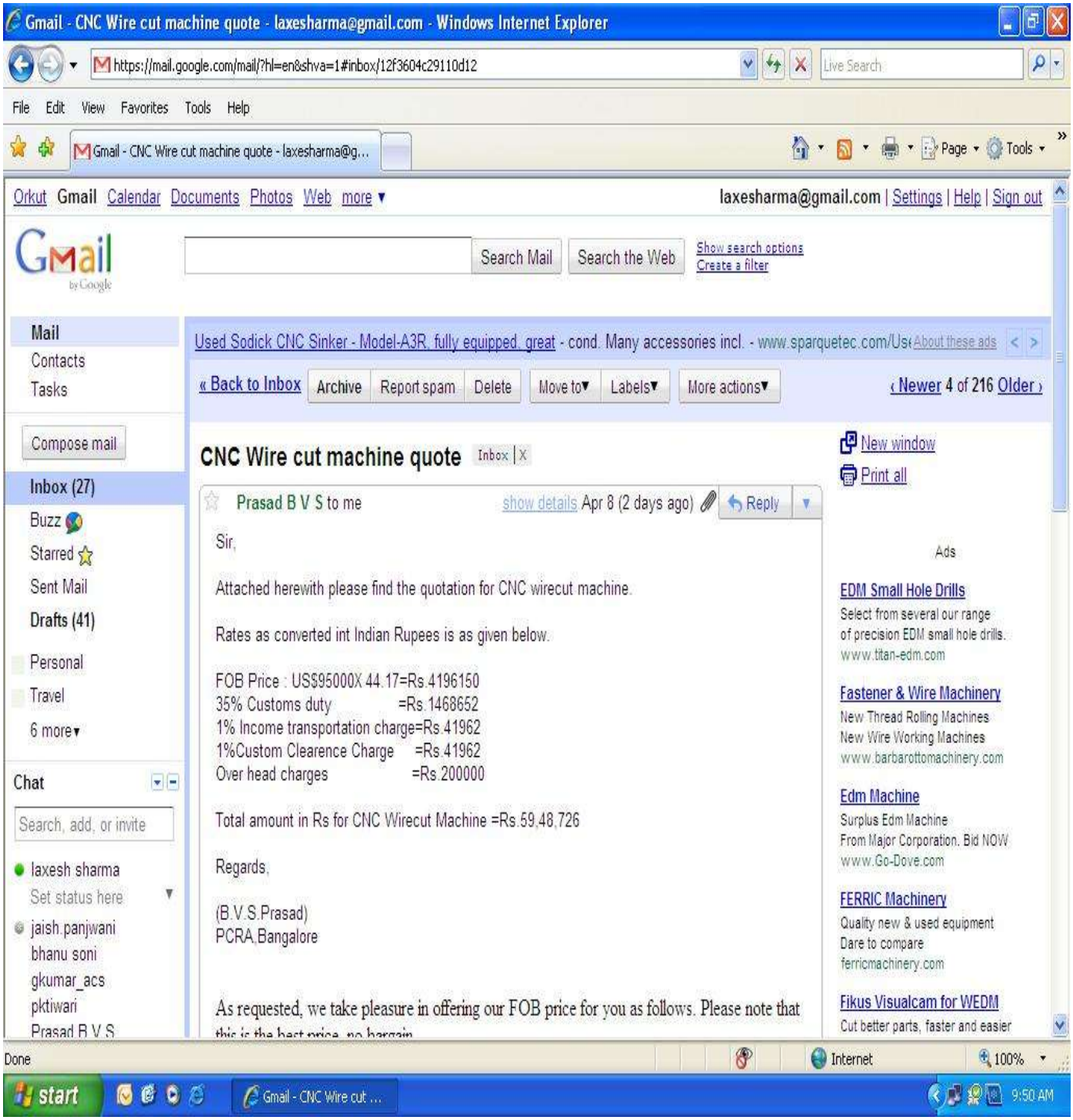
Annexure 6: Details of technology/equipment and service providers

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

Specification CNC WIRE CUT Machines	
Applications	**Properties**
Tension:	12V - 24W
Length of the hot wire:	150 mm
PS-3629	Filicut only
PYRO-R200 Transformer	230/9-12V 20/100e
Fil-3631	Tube of 10 hot wires
Time to heat:	6 to 8 seconds
Power:	230V - 60W
Heating temperature:	600°C
Length of the blades:	according to the blade
HSG 0 Machine	only 230V
Blade R	Blade length 29 mm
Blade HS-SG	Curved blade
Support SF	Cutter foot

Technical Specifications for CNC WIRE CUT Machines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Prasad B V S to me
show details Apr 8 (2 days ago)
Reply
Sir,
Attached herewith please find the quotation for CNC wirecut machine.
Rates as converted int Indian Rupees is as given below.
FOB Price : US$95000X 44.17=Rs.4196150
35% Customs duty =Rs.1468652
1% Income transportation charge=Rs.41962
1%Custom Clearence Charge =Rs.41962
Over head charges =Rs.200000
Total amount in Rs for CNC Wirecut Machine =Rs.59,48,726
Regards,
(B.V.S.Prasad)
PCRA,Bangalore
As requested, we take pleasure in offering our FOB price for you as follows. Please note that
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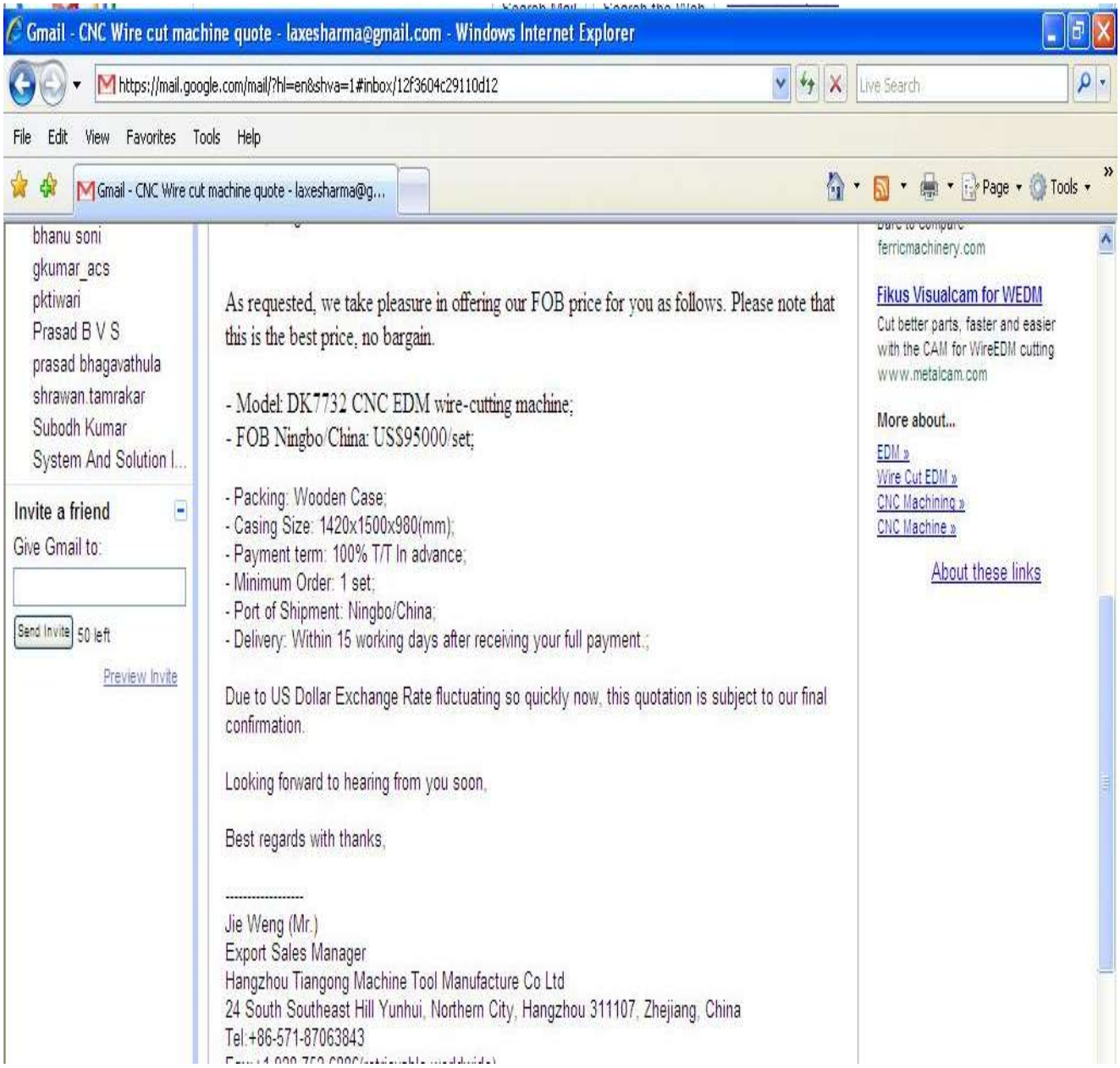
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Send Invite
50 left
Preview Invite
As requested, we take pleasure in offering our FOB price for you as follows. Please note that this is the best price, no bargain.
- Model: DK7732 CNC EDM wire-cutting machine;
- FOB Ningbo/China: US$95000/set;
- Packing: Wooden Case;
- Casing Size: 1420x1500x980(mm);
- Payment term: 100% T/T In advance;
- Minimum Order: 1 set;
- Port of Shipment: Ningbo/China;
- Delivery: Within 15 working days after receiving your full payment.;
Due to US Dollar Exchange Rate fluctuating so quickly now, this quotation is subject to our final confirmation.
Looking forward to hearing from you soon,
Best regards with thanks,
Jie Weng (Mr.)
Export Sales Manager
Hangzhou Tiangong Machine Tool Manufacture Co Ltd
24 South Southeast Hill Yunhui, Northern City, Hangzhou 311107, Zhejiang, China
Tel:+86-571-87063843
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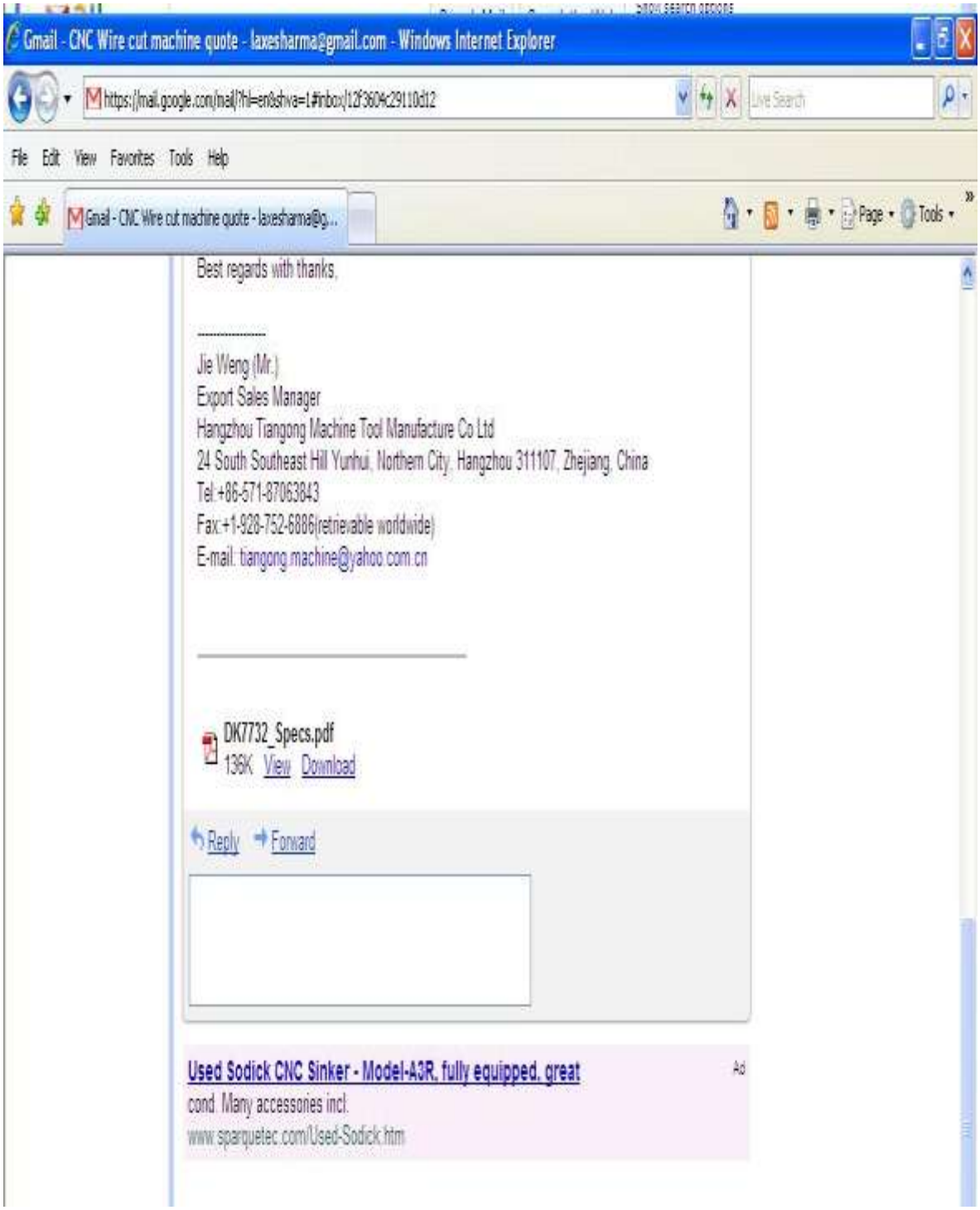
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Jie Weng (Mr.)
Export Sales Manager
Hangzhou Tiangong Machine Tool Manufacture Co Ltd
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Model	Worktable Stroke(mm)	Max. Thickness (mm)	Max. Bearing Capacity(kg)	Machining Accuracy(mm)	Machining Roughness(um)	Diameter of Molybdenum Wire (mm)	Overall Size of Mainframe(cm)	N.Wt.(kg)
DK7732	320x400	80-400	200	±0.015	Ra≤2.5-6.3	φ0.12~φ0.20	150x120x1400	850

Hangzhou Tiangong Machine Tool Manufacture Co Ltd
24 South Southeast Hill Yunhui, Northern City, Hangzhou 311107, Zhejiang, China
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Fax:+1-928-752-6886
E-mail:tiangong.machine@yahoo.com.cn

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

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