REPLACEMENT OF CONVENTIONAL LATHE MACHINES WITH SPECIAL PURPOSE MACHINES

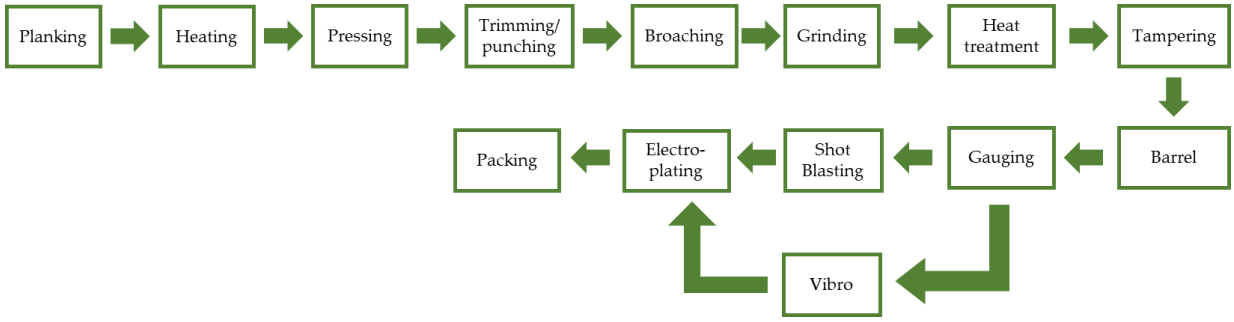
(For Punjab Forging and Foundry Cluster)

Cluster Brief:

Forging industry is one of the leading industry of India in terms of Production, exports, employment and also energy consumption. This industry needs energy in each and every process of value addition. Just like any other industry in India, the forging industry is also facing stiff competition from international market due to efficient technologies and their cost competitiveness. The major forging clusters are highlighted in the adjoining representative map of India.

In North India, Jalandhar and Ludhiana districts of Punjab are the major hub of forging industry. The units present in the area are engaged in production of hand tools, railway equipment, automotive parts and agricultural equipment.

The production processes followed in hand tool and automotive parts is shared below:



Process in hand tool manufacturing

Process in automotive parts manufacturing

Existing practice:

Many forging units in Ludhiana and Jalandhar region are using conventional lathe machines. These machines are used to complete processes like grinding, turning, threading, boring etc. For completing each task one machine has been dedicated and the job-piece travels to each machine depending on the processes that are to be completed on that job piece. Also, each of these machines need at least one operator to operate the machine. This leads to the following challenges:

1. Longer time taken to complete each job
2. Higher electricity/ energy consumption due to operation of multiple jobs on multiple machine.
3. Need of separate operator for each machine
4. Manual process lead to higher rejection in high precision work.

Proposed technology:

Based on the initial surveys, energy audits of six (6) forging units and discussions with various unit owners, we understand that a *Special Purpose Machine* is a good alternative over conventional lathe machines. It is identified that the installation of such technology will cater the multiple task through a single machine and reduce energy, manpower and space requirement. It may also decrease the production time of each job.

Justification of technology selection:

Every process of a forging industry needs some sort of energy for completion. Even though, thermal energy in heating furnace is major consumption area for energy, the machining section has the second largest area of electrical consumption (only after electroplating). This increases the importance of energy efficiency in machining section for any forging unit. Apart from saving electrical energy and improving energy efficiency, the special purpose machine shall have following added advantages:

1. Improved product quality
2. Reduced production time
3. Increases production capacity
4. Directly impacting the associated costs in a positive manner

Despite above mentioned advantages, following challenges have significantly affected propagation of this technology:

- *Higher cost:* The cost of SPM is high and its cost is directly dependent on number and type of operations to be combined in one machine.
- *Production:* The scale of operation determines suitability of technology to a large extent as monetary savings achieved are in direct proportion to the production.
- *Skilled manpower:* A single operator can operate SPM to perform two or more operations compared to traditional operator who is skilled to perform only one operation in a machine.

Energy & monitoring saving:

For calculating the energy and monetary benefits, three operations have been considered; threading, turning and grinding. The saving calculations are as below:

Parameters	Unit	Values
Measured power consumption of threading machine	kW	4.1
Total duration of measurement	sec	290
Number of pieces produced in measured duration	pc	10
Processing time for 1 piece	sec	29
Electricity consumed to produce 1 piece	kWh	0.033
Weight of one piece	kg	2.160
Electricity consumed to produce 1 kg	kWh/kg	0.015
Measured power consumption of turning machine	kW	0.48

Parameters	Unit	Values
Total duration of measurement	sec	166
Number of pieces produced in measured duration	pc	10
Processing time for 1 piece	sec	16.6
Electricity consumed to produce 1 piece	kWh	0.019
Weight of one piece	kg	0.220
Electricity consumed to produce 1 kg	kWh/kg	0.160
Measured power consumption of grinding machine	kW	4.300
Total duration of measurement	sec	170
Number of pieces produced in measured duration	pc	10
Processing time for 1 piece	sec	17.0
Electricity consumed to produce 1 piece	kWh	0.020
Weight of one piece	kg	0.400
Electricity consumed to produce 1 kg	kWh/kg	0.051
Measured power consumption of SPM (CNC type) machine (turning + threading + grinding)	kW	0.93
Total duration of measurement	sec	90
Number of pieces produced in measured duration	pc	1
Processing time for 1 piece	sec	90
Electricity consumed to produce 1 piece	kWh	0.023
Weight of one piece	kg	0.600
Electricity consumed to produce 1 kg	kWh/kg	0.039
Electricity savings per kg	kWh/kg	0.037
Annual production	T	500
Annual electricity savings	kWh	18,682.57
Cost of 1 kWh electricity	₹	7.5
Monetary savings from electricity	₹	1,40,119.25
Manpower cost	₹/month	8,857
Number of labour saved	No.	2
Savings in Manpower cost	₹	212,568
Increased production due to faster operation (5%)	T	25
Additional Electricity savings	kWh	934.13
Additional Monetary savings from electricity	₹	7,005.96
Total monetary savings	₹	3,59,693.21
Investment in SPM	₹	12,00,000
Payback period	Years	3.34

The payback period of this technology is highly dependent on annual production and variation in payback period with variation in annual production is provided in following table.

Annual production (Tons)	Payback (years)
100	4.96
200	4.43
300	4.00

Annual production (Tons)	Payback (years)
400	3.65
500	3.34
600	3.09
700	2.88
800	2.69
900	2.53
1000	2.38

Replication Potential:

Based on the discussion with associations, units, sample survey and energy audits, it is estimated that the technology has a replication potential in 30 units of the cluster with an annual average production of 500 tons. This replication potential is based on the survey of units conducted so far.

Parameters	Units	Values
Monetary savings due to SPM, labour reduction and increased production	₹	359,693.21
Number of units with replication potential	No.	30
Total cost saving estimated in 30 units	₹	10,790,796.31
Cost of replicating technology in 30 units	₹	36,000,000
Total GHG reduction estimated to reduce in 30 units	kg/year	535,535.77
Total TOE reduction	TOE	50.60

Availability of the technology

There are multiple technology providers available in India and many of them have their base in Ludhiana, Jalandhar, Amritsar or Chandigarh. The following are the technology providers available in the cluster.

1. Sukrit Machine Tools
   #3, Canal Industrial Complex, G.T. Rd. Bye Pass, Near Bhagat Singh Colony, Jalandhar, Punjab-144004
2. Lakshmi Machine Works Limited (LMW)
   Machine Tool Division, Arasur, Coimbatore, Tamil Nadu - 641407
3. Jyoti CNC automation Ltd.
   G-506 & 2839, Lodhika, G.I.D.C., Vill. Metoda, Dist: Rajkot, Gujarat -360021
4. SAP Takisawa Machine Tools Private Limited
   No. 33/33/5, Ground & First Floor, 'ANNAPOORNA', Kanakapura Road, Jaraganahalli, J.P. Nagar Post, Bangalore, Karnataka -560078
5. Haas Automation
   73-76 Karnavati Industrial Estate, Sardar Patel Ring Road, Odhav, Ahmedabad, Gujarat 382415

Effect on the process

Installing an SPM will reduce energy consumption, associated costs and reduce air pollution. In addition, installing SPM by replacing existing lathe machines will free up space in the factory for installing new machines and adding the production capacity.