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A STUDY ON IDENTIFYING SKILL & TECHNOLOGY GAP OF JASHORE LIGHT ENGINEERING CLUSTER

Department of Industrial and Production Engineering
Jashore University of Science and Technology

Final Report

On

A Study on Identifying Skill and Technology Gap of Jashore Light Engineering Cluster

Submitted to

SME Foundation
Royal Tower, 4 Panthapath
Dhaka-1215

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Acknowledgement

We would like to express our gratitude and sincere appreciation to **SME Foundation** who financed the whole study.

We would like to express our thanks to **Bangladesh Engineering Industries Owners Association (BEIOA), Jashore** for their valuable support for conducting the study.

We would like to acknowledge our greatest thanks to **all foundry and machining industries owners and workers** for their support in understanding the skill and technology gaps in the cluster.

We would like to express our thanks to honorable **Vice-Chancellor of Jashore University of Science and Technology (JUST)** for his support to conduct this study.

We express our thanks who directly and indirectly helped us for completion of the study.

At last, we are unfortunately not able to include all the names of all those who have contributed to perform this project work

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Executive Summary

This study has addressed the present state of the skill and technology of Jashore Light Engineering Cluster. This study has also identified the present capability and future potential of the cluster as well as the skill and technology gap. Time-bound strategies and interventions are also developed for reducing the skill and technology gap.

Light Engineering (LE) sector is one the promising sectors in Bangladesh. This sector produces around 50% substitutes of the products that were previously imported from other countries. Jashore Light Engineering cluster is one of the prominent industrial zones located in the southwestern region of Bangladesh. According to Bangladesh Engineering Industry Owners' Association (BEIOA), 246 listed workshops are located in this cluster and the major products and services of this cluster are stone crasher machine, manual chaff cutter machine, agricultural machines and tools, automobile parts, mixer machines, poultry and fish feed machines and other repairing services. However, the current performance of light engineering sectors is not in the satisfactory level. Therefore, it is important to identify and study the skill and technology gap of light engineering sectors in Jashore. In that case, it is very essential to have deeper understanding of the technical situation, export potentials and required skills of light engineering sectors in solving their problems and managing their businesses more effectively for survival, growth and sustainability.

The purpose of this study was to identify the skill and technology gap of the light engineering workshops in the Jashore Cluster. This study was carried out with the financial support of SME Foundation, Bangladesh. A total of 193 industries were surveyed; among them 15 were foundries and 178 were engineering workshops. A total of 223 persons were interviewed; among them 181 were owners and, 12 were supervisors and 30 were workers.

Although most of the foundries employ the modern casting technology, they have knowledge gap about the materials composition, mold, heat treatment etc. On the other hand, the engineering workshops are using the conventional machines and equipment. Training and common information repository are required for the owners and workers of foundry industries. Semi-automatic and modern machines can be introduced in the engineering workshops to improve the productivity and the quality of the products.

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CHAPTER 1
INTRODUCTION

1.1 Cluster Development Concepts

The economy of Bangladesh has been growing at a steady rate since past few years. However, the economy of the country is highly dependent on the agricultural sector. Only agriculture alone can't take this economy any further. The one and only way to sustain our GDP growth greater than 6%, which the country has successfully maintained for the past eight years (2011-2018)[1], is to focus on the industrialization of the country. Nevertheless, the socio-economic state of the country has to be more stable for going all-out towards Large-Scale Industrialization. As a result, Small and Medium Enterprises (SMEs) are the most realistic approach for economic and social development. Through employment creation, income generation and poverty alleviation, SMEs can change the whole scenario of the country. The Government of Bangladesh has taken various steps for SME development across the country; Formation of Small and Medium Enterprise Foundation (SME Foundation) is such an initiative. As most SMEs are located in geographically dense locations called 'Clusters'; it is of great importance to understand existing situation, identify problems and potentials of SME clusters in order to formulate suitable interventions for their development. Till date, SME Foundation has identified 177 SME Clusters in 51 districts of Bangladesh.[2] There are maximum 38 Handicrafts & Miscellaneous clusters followed by 34 Agro-Processing/Agri-business/Plantation, 31 Light Engineering and Metal working, 22 Knitwear & Readymade Garments, 16 Fashion Rich Effects, Wear & Consumers Goods, 13 Leather Making & Leather Goods clusters, 10 Handloom &Specialized Textiles clusters, 5 Healthcare & Diagnostics clusters, 3 Plastics & Other Synthetics, 3 Electronics & Electrical, and 2 Educational Services clusters in Bangladesh. These clusters are located in 51 different districts and there are 13 districts namely Netrokona, Rajbari, Narail, Meherpur, Lalmonirhat, Sunamganj, Barguna, Bhola, Patuakhali, Noakhali, Bandarban, Rangamati and Khagrachari where no clusters are found[2].

Light Engineering Industry (LEI) may be called the "heart" of all industry segments in Bangladesh. As a result, they have been stated as one of the highest priority sectors in the

[1] https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2018&locations=BD&start=2011 (Accessed at 11.00 am, 08.02.2020)
[2] https://joynal.wordpress.com/2018/03/30/role-of-sme-clusters-in-bangladesh-economy/ (Accessed at 12.00 pm, 08.02.2020)

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National Industrial policy 2016. It has emerged as a potential cost-cutting sector by accounting for around 50% substitutes of the products that were previously imported from other countries.[3] This sector is providing critical support to other heavy-industrial, agricultural and construction sectors by manufacturing a wide range of spare parts, castings, molds and dices, oil and gas pipeline fittings and light machinery, as well as repairing those. Multiple survey data suggest that electrical goods such as switch, socket, light shed, channel, cables and electrical fans, generator, which are manufactured by the LEIs, are now meeting 48% to 52% of the country's demands, which was previously met through import.[3] Export growth is projected to be around 30%.[3] It also provides backup support to cement, paper, jute, textile, sugar, food processing, railway, shipping, garments capital machineries by repairing and maintaining the important parts. A recent study conducted by International Finance Corporation (IFC) in partnership with UK Department for International Development and Norwegian government has shown that LEI has employed thousands people involved 10,000 Small and Medium Enterprises.[3] The sector is suffering from technological obsolescence, low productivity, lack of market linkage, etc. Major LEI clusters are located in Dhaka, Chattogram, Sylhet, Bogura and Jashore. The purpose of the study is to in terms assess technological situation of Jashore Light Engineering Cluster. The study will also emphasize export potential, value chain development and opportunity for sub-contracting and production networking for the Jahore Light Engineering Cluster.

1.2 Description of Jashore Light Engineering Cluster

Jashore Light Engineering cluster is one of the prominent industrial zone located in the southwestern region of Bangladesh. Light engineering industries in Jashore are manufacturing parts for vehicles, shallow machines, stone breaking machines, agricultural machineries etc. According to Bangladesh Engineering Industries Owners Association (BEIOA), Jashore, around 256 light engineering industries are spread across Jashore Light Engineering Cluster. The numbers of light engineering industries in different location of the cluster has been given in Table 1.1

[3] http://www.bpc.org.bd/lepbpc_current_sector_profile.php (Accessed at 01.00 pm, 08.02.2020)

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Table 1.1: Size and location of light engineering industries in Jashore Cluster

Location	Number of Light Engineering Industries
Shnkarpur & Jail Road	07
Rangamati Garage, Khaldhar Road	08
Naldanga, Notun Bazar	19
R N Road	08
Khajura Bus Stand & Old High Court Mor	16
Arabpur	07
Chancra & Puler Hat	19
Narail Road, Hamidpur	28
Murali Mor	24
Khulna Road, RAB Office	33
Aur Masjid, Khulna Road	36
Rajar Hat, Rupdia & Kanaitala	22
Keshabpur Bus Stand, Dhaka Road	12
Bscic, Jashore	17

1.3 Rationale of the Study

Light engineering Sector is one of the most important segments of economy in Bangladesh. Light engineering Sector is getting the highest priority from policymakers due to its already proven multidimensional contribution to the socioeconomic environment of our country. Honorable Prime Minister of Bangladesh has announced 'The Light Engineering goods' as 'Product of the year' for 2020. Light engineering enterprises are easy to start, require only minimum capital, employ a comparatively higher number of people, and produce goods that meet local demands as well as contribute to export earnings. This sector is a potential sector in terms of value additions and creation of employment opportunities. However, contribution of light engineering sector to GDP in Bangladesh is still in unsatisfactory level. According to SMEF Bangladesh, presently contribution of SMEs to GDP is estimated 25% of which 2% is from light engineering sector, which is still lower than many other countries.[4] These contributions need to be enhanced for maintaining the economic balance of our country. However, the major challenge for the government is to enhance the pace of growth of light engineering sector to place the country's economy in a sound place and get the benefits from

[4]Ahmed K, Chowdhury TA. Performance evaluation of SMEs of Bangladesh. International journal of Business and Management. 2009 Jul;4(7):126-33.

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globalization through maximum utilization of limited resources. Unemployment problem is another challenge for the government and it can be minimized through the development of light engineering sector. But, the current performance of light engineering sectors is not in the satisfactory level. Therefore, it is important to identify and study the skill and technology gap of light engineering sectors in Bangladesh. In that case, it is very essential to have deeper understanding of the technical situation, export potentials and required skills of light engineering sectors in solving their problems and managing their businesses more effectively for survival, growth and sustainability. For this reason, this particular study aims to identify the skill and technology gap of Jashore Light Engineering Cluster.

1.4 Objectives

The objective of the study are:

i. To explore the present state of the technology and skills in the Jashore Light Engineering Cluster.
ii. To explore present capability and future potential of the cluster.
iii. To identify technology and skill gap of Jashore Light Engineering cluster.
iv. To develop time-bound strategies and interventions for reducing the technology and skill gap.

1.5 The Methodology Followed by SMEF, Bangladesh and IPE, JUST for this Project

1. Detailed questionnaires are prepared in discussion to SMEF Bangladesh officials for understanding the skill and technology gap in the cluster. The detailed questionnaires have been given in Annexure 1, Annexure 2 and Annexure 3.
2. One to one interviews with the industry owners, supervisors and workers has been done in their factory and offices and are recorded. Some snapshots are attached in Annexure 4.
3. Three focused group discussions (FGDs) have been conducted with foundry owners, machining industry owners and workers regarding the skill and technology gap in the cluster. Some snapshots of FGDs are attached in Annexure 4.

1.6 Scope of the Study

The scope of the study is to focus on the assessment of technology and skill gap in the Jashore Light Engineering Cluster. The industries/workshops/units to be covered in this study will include all industries/workshops/units of the micro, small and medium scale involved in

manufacturing different casting parts and different machining and finishing operations as well as those industries/workshops/units involved in repairing different automobile parts. The main technologies used in this cluster include induction furnace, coal furnace, sand casting, and lathe machine, drill machine, milling machine, shaper machine, gas welding and some small hand tools. All these technologies are to be studied extensively to identify the gaps with the standard technological practice and to find out the solutions to these gaps. The study is to be done in close consultation with the existing industry/workshop owner, workers and supervisors. The findings of this study are to be validated by the stakeholders (industry associations, entrepreneurs, cluster experts, and government bodies) through a validation workshop to be organized before finalization and submission of the study to SME foundation.

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CHAPTER 2
METHODOLOGY

2.1 Research Design

This research was conducted as per following flowchart given in Figure 2.1. Each step has been broadly described accordingly.

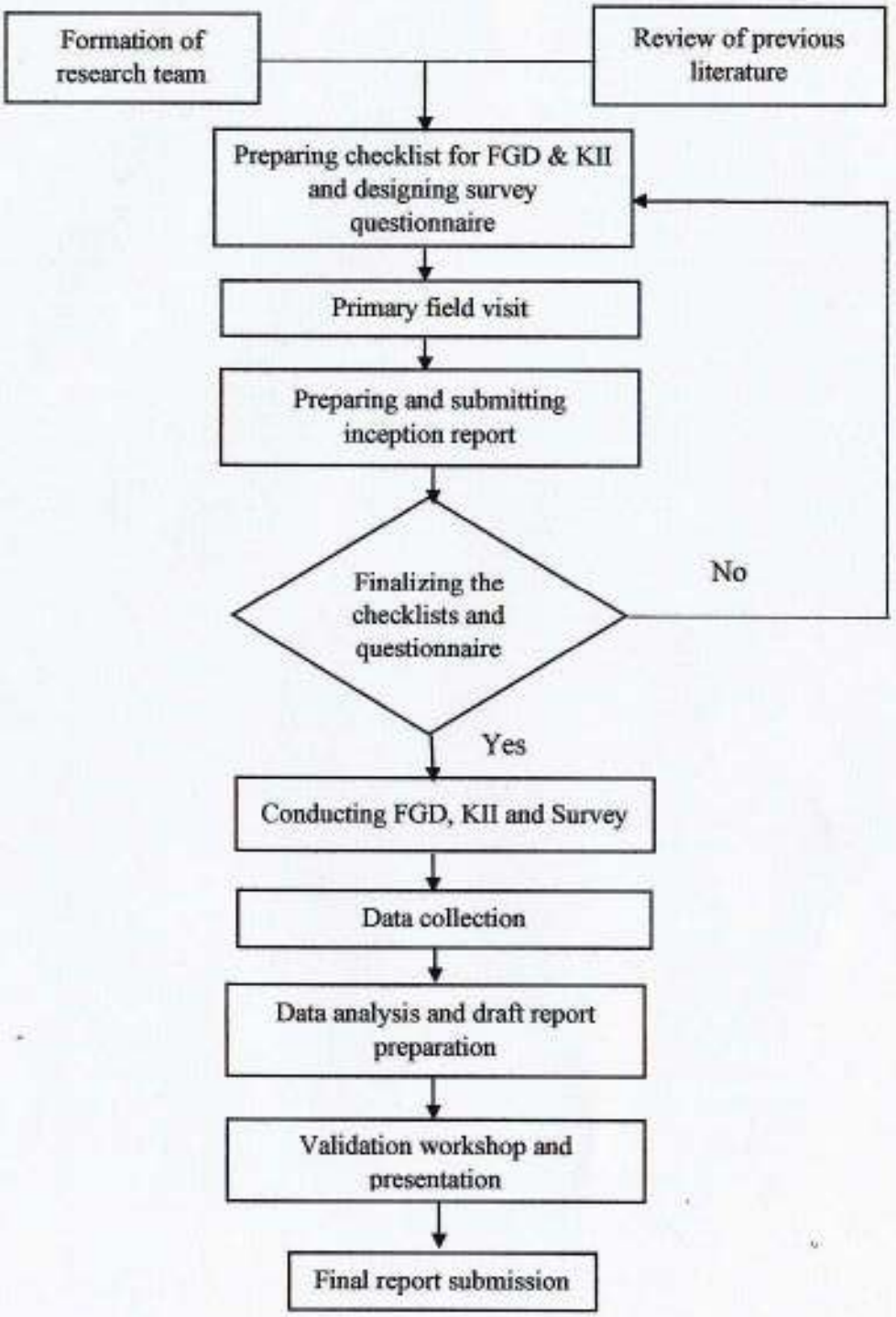

Figure 2.1: Flowchart of the current research

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2.2 Data Collection

This research have used both qualitative and quantitative approaches and will collect primary and secondary data. Primary data has been collected through key informant interview (KII), focus group discussion and field survey. Secondary data has been collected through different documents and reports.

2.3 Study Area and Sample Determination

Data has been collected from various stakeholders in Jashore Light Engineering Cluster. Initially, it was mentioned by Jashore Chamber of Commerce that there are 256 listed and 184 unlisted light engineering enterprises in Jashore Cluster, total number being 440. According to Cochran (1963) sampling technique, the sample size for survey is 210. However, according to the list provided by Bangladesh Engineering Industries Owners Association (BEIOA), Jashore, 246 light engineering industries were found, among which some of the industries have closed their businesses. Also, some of the industries listed didn't have a single lathe machine or milling machine, which are the key components of an engineering workshop. Therefore, this study was conducted on 193 light engineering industries in Jahsore Light Engineering Clsuter.

Notes: The population size (No. of light engineering enterprises) is collected from Bangladesh Engineering Industry Owners Association, Jashore branch. The population size is 440. To estimate the number of sample survey we followed Cochran (1963) sampling techniques. This technique uses the following formula to determine the sample size:

$$n = \frac{N}{1 + Ne^2}$$

Where, n is the sample size, N is the population size and e is the level of precision (Here, confidence interval is 95% so the precision e is 0.05).

2.4 Focus Group Discussion (FGD)

Three focus group discussions (FGDs) have been conducted for the cluster according to the types of industries. Two separate FGDs were conducted with the foundry owners and machining industry owners respectively. One FGD has been conducted with the workers and technicians. This research has used audio and video recorder for transcription purpose. In this study, the researchers have prepared a discussion guide for FGDs. FGD will include the following participants:

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i. Foundry owners
ii. Machining industry owners
iii. Workers and technicians

2.5 Key Informant Interview (KII)

KII has been conducted for primary data collection and will be conducted for validation of the data. Altogether seven (07) KIIs were conducted. In KIIs several notable stakeholders have been interviewed and their opinions were sought by using a KII checklist. The participants for KII were:

i. Pattern makers
ii. Raw materials supplier
iii. Chemical suppliers
iv. Bank manager
v. Consultant

2.6 Survey and Interview Procedure

The survey and interviews were conducted in both structured and semi-structured nature. All the necessary information about the enterprises were collected according to the questionnaires and checklists which were prepared in consultation with SME foundation officials (Annexure 1, Annexure 2 and Annexure 3). Interviews were digitally recorded and noted on papers with the permissions of interviewees.

2.7 Data Analysis

The data has been analyzed using appropriate descriptive tools (for example, syntax, charts, and cross-tables etc.) and multivariate techniques. SPSS and Microsoft Excel were used for data analysis purpose.

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CHAPTER 3

CURRENT LIGHT ENGINEERING SCENARIO

3.1 Global Industrial Scenario

Industrialization is one of the basic requirements for the overall economic development of a country. A country can never sustain its development through agriculture, IT or business alone. They have to focus on industrialization. The countries that are currently dominating the global economy are all industrially developed. Figure 3.1 shows the top 20 countries with most industrial output. Anyone and everyone will notice that almost all of these countries are either developed (like USA, China, Germany, etc.) or are trying to become developed ones (like India, Brazil, etc.). These are also the ones with most economic growth in recent world. Therefore, industrialization and economic growth are almost synonymous.

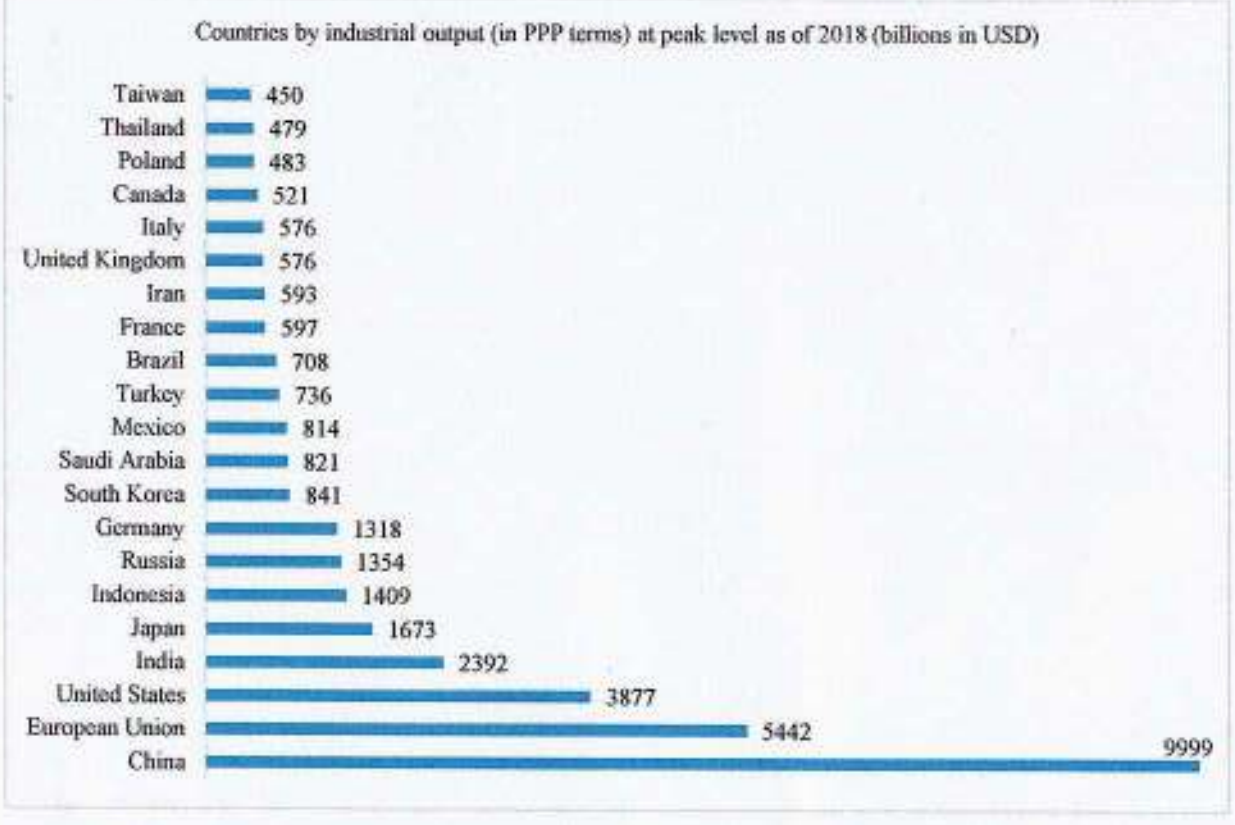

Figure 3.1: Top 20 countries with most industrial output (Source: IMF, 2018)

From the above figure, it may be easily understood that China alone is currently dominating the market with its industrial expansion. Their vast country landscape and population makes it possible. Another reason for their economic boom is that they are focusing on both heavy engineering and light engineering sectors which most other countries are relying on the light

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engineering output of China to maintain their own heavy industries. This is why China has a steady market with a constant demand for light engineering products.

Recently, Taiwan has come to the focus of the global investors due to their light engineering growth. They have entered into the top 20 industrial countries only because of their light engineering sector. In many cases, their products are the substitutes of Chinese products.

Another country from South Asia that has grown fast is India, out neighbor. They are in the third spot in global industrial output. They, just like China, have a vast land with huge population resource. As a result, their industrial sector is growing very rapidly. They are not only focusing on heavy engineering industry but also on light engineering industries. Their light engineering section has been able to support the local demand quite easily and are exporting to other countries like Bangladesh, Sri Lanka, etc.

Since it is almost impossible for a country to achieve industrial growth of China or India overnight, it is logical to focus on what is to be done first in order to lay the foundations of the growth. The best example is indeed Taiwan, which has grown through Light Engineering alone. India has also shown that it is possible to save and earn foreign currency if light engineering industries are developed enough. These two countries should be the role-models for the industrial development of our country.

3.2 Current Scenario of Light Engineering Industries in India

India is one of the largest countries of the world with a growing economy. They have achieved their constant economic growth through industrialization. The engineering sector is the largest of the industrial sectors in India. It can be classified into two parts; heavy engineering and light engineering. India's engineering industry accounts for 27% of the total factories in the industrial sector and represents 63% of the overall foreign collaborations[5].

The light engineering sector has a major contribution to the overall economy of the country. As on 2014, there were 22 public enterprises alone in medium and light engineering group with an annual turnover of 14982 Crore Rupees[6]. The number of private enterprises is far greater with much higher annual turnover. India is the 8th highest consumer and 12th in production of machine tools globally[7]. Nearly 12% of India's total manufacturing is

[5] https://www.equitymaster.com/research-it/sector-info/engg/Engineering-Sector-Analysis-Report.asp (Accessed at 03.00 pm, 10.02.2020)
[6] Pub Enterprises Survey 2013-14, Vol II, India
[7] https://www.ibef.org/industry/engineering-india.aspx (Accessed at 04.00 pm, 10.02.2020)

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contributed by the capital goods industry[8]. The sector is growing at steady rate for the past few years, as shown in Figure 3.2. Turnover of capital goods industry is estimated to be around USD 70 billion in the year 2017[2]. India exports its engineering products to the US and Europe, which is over 60% of the total exports. Engineering exports for the period of FY19 were US$ 81.02 billion[2].

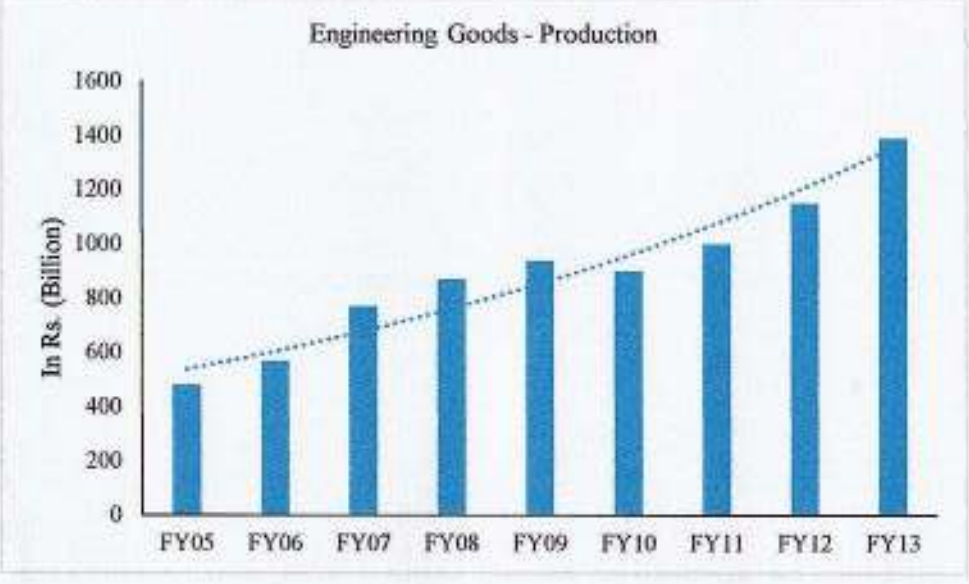

Figure 3.2: Growth of capital goods industry in India (SME Cluster Series 2014: Mumbai)

The government of India is also trying their level best to promote this sector as much as possible. Government has proposed granting of loans up to Rs 1 crore (US$ 0.15 million) for Micro, Small and Medium Enterprises (MSMEs) through dedicated online portal. Under the Interest Subvention Scheme for MSMEs, Rs 350 crore (US$ 52.50 million) has been allocated for FY 2019-20[9].

3.3 Current Scenario of Light Engineering Industries in Taiwan

Taiwan is a great example of how a country can rise with the help of its Small and Medium Enterprises (SMEs) This small island's 1.4 million small to medium-sized enterprises (SMEs) account for 98% of all private-sector companies and employ 80% of the workforce[10]. Taiwan's industrial production index gained 6.08% year on year to a record 112.26 points in July, 2019 on the back of growth in manufacturing and utilities, according to the Ministry of Economic Affairs[11]. Manufacturing accounts for about 93% of the weighting, gained 6.77%[7].

[8] https://www.dnb.co.in/Publications/SME_cluster_series2014_Mumbai/EnggOverview.asp (Accessed at 08.00 pm, 11.02.2020)
[9] https://www.ibef.org/industry/indian-engineering-industry-analysis-presentation Accessed at 08.30 pm, 11.02.2020)
[10] https://www.forbes.com/custom/2019/07/15/taiwan-a-bright-future/ Accessed at 09.00 pm, 11.02.2020)
[11] https://taiwantoday.tw/news.php?unit=6&post=12103 Accessed at 09.10 pm, 11.02.2020)

Taiwan has maintained good global competitiveness rank for the past few years, as shown in Figure 3.3. This has been possible due to its manufacturing sector, mostly the light engineering sector.

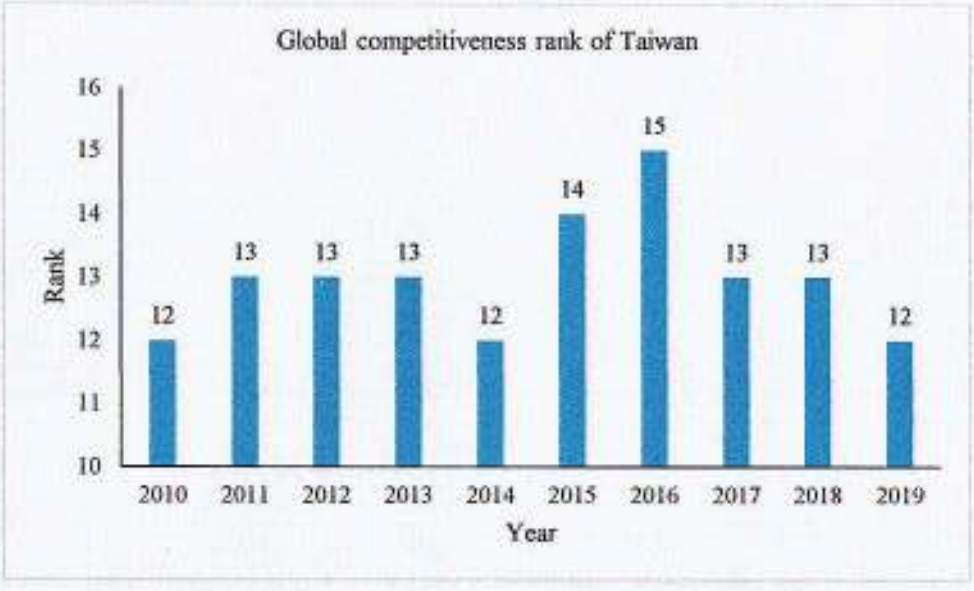

Figure 3.3: Global competitiveness rank of Taiwan (Source: World Economic Forum, 2019)

3.4 Light Engineering Sector in Bangladesh

SME foundation has identified 177 SME clusters in Bangladesh, of which 31 are Light Engineering Clusters (17.5%). It is believed that around 7,392 enterprises are operating in these clusters. The annual turnover of the enterprises of these clusters is around 225,456 million in BDT (USD 2.66 billion). This is nothing compared to the annual turnover of our neighbor, India. However, it is to be noted that the size and population of India is far greater than that of Bangladesh. Nevertheless, it is much lower than the annual turnover of Taiwan, which is much smaller in size and population. Therefore, it may be stated that Bangladesh has a long way to go to achieve industrial development through Light Engineering Sector.

3.5 Jashore Light Engineering Cluster

According to the SME Cluster Report-2013[12], Jashore light engineering and metal working cluster may be divided into two product categories:

- Bodies of motor cars, repairing, lade and coloring: These industries are located in Bokchar and Jashore Sadar. The number of enterprises is found to be 900 with approximately 6,000 Decimal land area and 20,000-30,000 employees in 2013.

[12] Cluster Report 2013, SME Foundation

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- Textile mills parts, concrete breaking machine, medicine making machine: These industries are located in Jashore Sadar. The number of enterprises is found to be 200 with approximately 50,000 Decimal land area and nearly 40,000 employees in 2013.

From the SME Cluster Report-2013, it may be observed that the number of industries in Jashore cluster is found to be 1100 in 2013. This includes both light engineering industries (foundries, welding shops, etc.) and metal work industries (sheet metal industries, truck body building industries, etc.). There are a variety of products manufactured in the enterprises of this cluster. However, this study focuses on the light engineering sector, i.e. the foundries and engineering workshops located in Jashore cluster. Therefore, the number of industries which are within the scope of this study is much lower than the total number of industries in this cluster. Also, the SME Cluster Report is more than 6 years old. During this time period, many industries in this cluster have shut down due to lack of facilities and development in this cluster. Table 3.1 presents the current scenario of the light engineering sector in Jashore Cluster.

Table 3.1: Summary of Jashore Light Engineering Cluster

Cluster Category	Light Engineering
Location	Jashore
Cluster Sub-category	Foundry and Engineering Workshop
Number of Enturprises Foundry Engineering Workshop	 15 178
Number of Employees Foundry Engineering Workshop	 856 (793 Male and 63 Female) 1179 (1173 Male and 6 Female)
Average number of employees/ Enterprise Foundry Engineering Workshop	 57 7
Products Foundry Engineering Workshop	 Centrifugal Pump, Tube-well, Automobile Parts, Agricultural Machine Parts, Ship Propeller, Aluminum Products, etc. Automobile Parts, Agricultural Machinery, Food Industry Machinery, Textile Mill Machinery, Construction Industry Machinery, Brick Field Accessories, Saw Mill, etc.
Total Annual Turnover (Tk. in millions)	5791.2 (Approx.)
Annual Raw Material Consumption Foundry Iron (in Tons) Aluminum (in Tons) Carbon Block (in Tons) Molasses (in Barrels) Sand (Trucks) Carbon Powder (Bags) Talcum Powder (Bags) Engineering Workshop	 12,360.0 (Approx.) 271.2 (Approx.) 529.7 (Approx.) 732 (Approx.) 744 (Approx.) 660 (Approx.) 1,980 (Approx.)

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Iron [in the form of MS or CI] (in Tons)	3438.2 (Approx.)
Aluminum	54.6 (Approx.)
Brass	81.0 (Approx.)

According to Bangladesh Engineering Industry Owners' Association of Jashore, there are around 300 heavy and light engineering industries in Jashore. It is also assumed that this district alone has an annual production of goods worth 10,000 million in BDT (USD 117.73 million)[13], which is significant enough. This sector has grown without the help and support of the government. Therefore, he believes the government initiative can take this light engineering sector to a much higher state.

[13] en.bbarta24.net/special-stroy/2016/06/02/2394

CHAPTER 4

TECHNOLOGIES IN THE CLUSTER

4.1 Existing Technologies in the Foundry Industries of the Cluster

Like any other foundry industry, the foundry industries in Jashore Light Engineering Cluster employ two basic processes; metal melting and casting. Due to seasonal variation of product demands in this region, all of the foundries in this cluster have chosen sand casting process. For metal melting, they have chosen different types of furnaces. The existing technologies in the foundry industries of this cluster are presented in this section.

4.1.1 Sand Casting

Sand casting is the most widely used casting process, accounting for 60% of all the metal casting processes. In this casting process, expendable sand molds are prepared to form cavities of the exact shape of complex metal parts. Since the sand mold has to be destroyed in order to remove the part, sand casting has a low production rate. However, the investment cost for sand casting is very low and sand is quite abundant in nature. This is why it is preferred for most casting purposes.

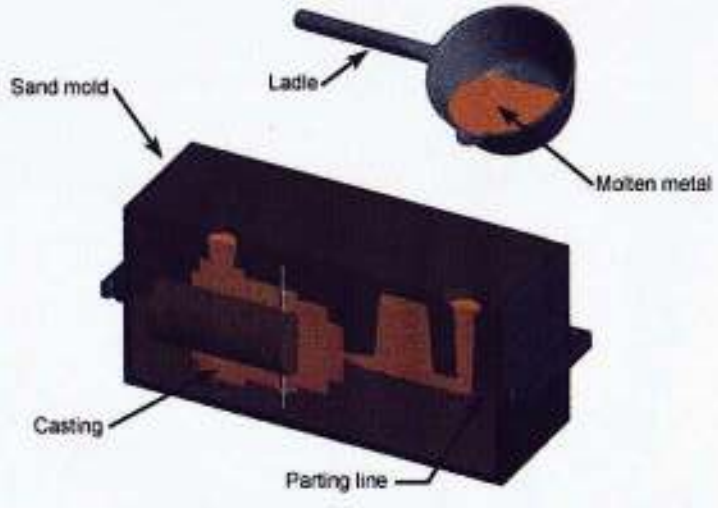

Figure 4.1: Sand Casting Process (Image Courtesy: custompartnet.com)

In sand casting process, metal is melted in the furnace and then poured into the cavity of the sand mold, which is formed with the help of a pattern. After solidification, the metal part is removed from the sand mold. The process cycle for sand casting has six stages, which are:

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- Mold-making: The first step in the sand casting process is to create the mold. A sand mold is formed by packing sand into a molding box. The mold box has two parts; cope and drag. Sand is packed around the pattern, which has the exact shape of the part to be cast. When the pattern is removed, a cavity is formed where metal will be solidified. If there is any internal feature that cannot be formed by the pattern, separate cores made of sand are used. The mold-making time includes positioning the pattern, packing the sand, and removing the pattern. The surface of the cavity is then heated and baked to increase strength of the mold. Lubrication is often applied to the surfaces of the mold cavity to facilitate easy removal of the cast metal part.
- Clamping: Once the mold is ready, the molding box halves are closed and clamped together.
- Pouring: The molten metal in the furnace is poured in the mold cavity using a tapered passage called runner. Enough molten metal must be poured to fill the entire cavity. To account for the shrinkage of the molten metal, excess molten metal is stored in a separate reservoir cavity is prepared in the sand mold called riser.
- Cooling: Once the molten metal is inside the cavity, it starts to solidify due to cooling. The mold cannot be opened until all the molten metal has solidified.
- Removal: After solidification process, the sand mold is destroyed to remove the cast metal part. Once removed, the cast product may have some sand and oxide layers over its surface. Proper cleaning is required to remove sand from the external surface of the part.
- Trimming: In order to account for casting defects, the mold cavity is usually made larger than the original size of the desired product. This excess material due to the larger shape must be trimmed by machining. The scrap material resulting from machining process is either discarded or reused in the sand casting process.

4.1.2 Crucible Furnace

Crucible furnaces are one of the oldest and simplest types of melting unit used in a foundry. The furnaces use a refractory crucible which contains the metal charge. The charge is heated via conduction of heat through the walls of the crucible. The heating fuel is typically coke, oil, gas or electricity. Crucible melting is commonly used where small batches of low melting point alloy are required. The capital outlay of these furnaces makes them attractive to small non-ferrous foundries. In Jashore LE cluster, the foundries that produce aluminum products use crucible furnaces.

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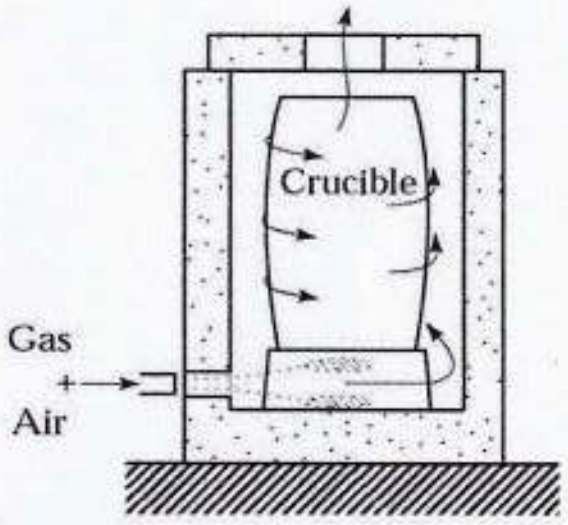

Figure 4.2: Crucible furnace (Image courtesy: researchgate.com)

4.1.3 Cupola Furnace

A cupola or cupola furnace is a melting device used in foundries that can be used to melt cast iron, Ni-resist iron and some bronzes. The cupola can be made almost any practical size. In Jashore LE cluster, the industries producing cast iron products are mostly using this technology. The melting capacity ranges 3-10 Tons and the number of charges is usually 2-3 times a week.

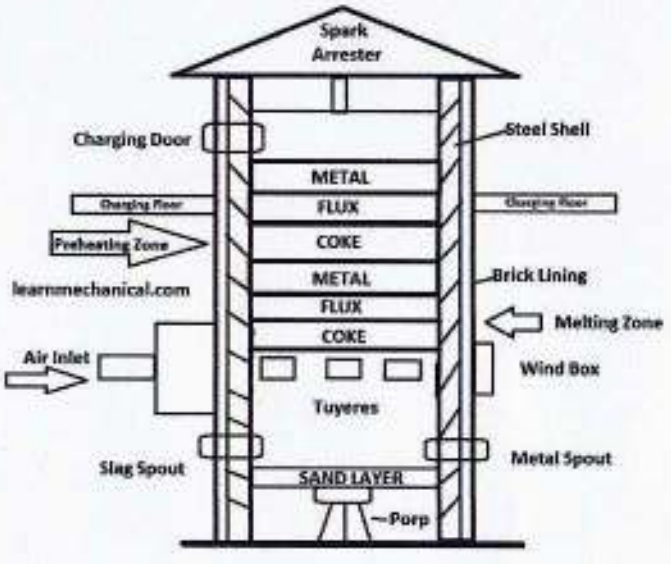

Figure 4.3: Cupola furnace (Image courtesy: learnmechanical.com)

The construction of a conventional cupola consists of a vertical steel shell which is lined with a refractory brick. The charge is introduced into the furnace body by means of an opening approximately half way up the vertical shaft. The charge consists of alternate layers of the

metal to be melted, coke fuel and limestone flux. The fuel is burnt in air which is introduced through tuyeres positioned above the hearth. The hot gases generated in the lower part of the shaft ascend and preheat the descending charge.

Most cupolas are of the drop bottom type with hinged doors under the hearth, which allows the bottom to drop away at the end of melting to aid cleaning and repairs. At the bottom front is a tap hole for the molten iron at the rear, positioned above the tap hole is a slag hole. The top of the stack is capped with a spark/fume arrester hood.

Typical internal diameters of cupolas are 450 mm to 2000 mm diameter which can be operated on different fuel to metal ratios, giving melt rates of approximately 1 to 30 tons per hour.

A typical operation cycle for a cupola would consist of closing and propping the bottom hinged doors and preparing a hearth bottom. The bottom is usually made from low strength molding sand and slopes towards a tapping hole. A fire is started in the hearth using light weight timber; coke is charged on top of the fire and is burnt by increasing the air draught from the towers. Once the coke bed is ignited and of the required height, alternate layers of metal, flux and coke are added until the level reaches the charged doors. The metal charge would typically consist of pig iron, scrap steel and domestic returns.

An air blast is introduced through the wind box and tuyeres located near the bottom of the cupola. The air reacts chemically with the carbonaceous fuel thus producing heat of combustion. Soon after the blast is turned on, molten metal collects on the hearth bottom where it is eventually tapped out into a waiting ladle or receiver. As the metal is melted and fuel consumed, additional charges are added to maintain a level at the charging door and provide a continuous supply of molten iron.

At the end of the melting campaign, charging is stopped but the air blast is maintained until all of the metal is melted and tapped off. The air is then turned off and the bottom doors opened allowing the residual charge material to be dumped.

4.1.4 Induction Furnace

Electric induction furnace uses the electric current to melt metal. Metals which are melted in an induction furnace include iron and steel, copper, aluminum, and precious metals because it is a clean and non-contact process. It can be used in a vacuum or inert atmosphere. Induction furnaces are used in most modern foundries as a cleaner method of melting metals than cupola furnace. The foundries involved in producing mild steel (MS) products have adopted

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this new technology. The melting capacity ranges 1-2 Tons and the typical number of charges is 2 times a day.

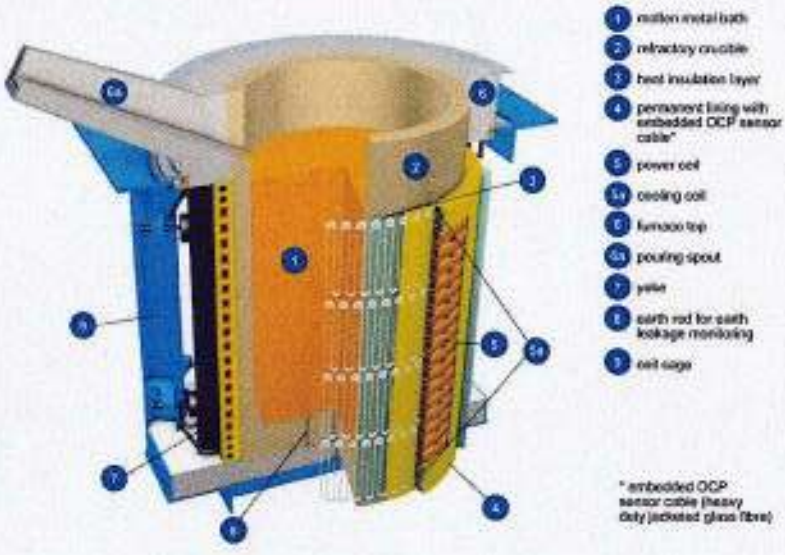

Figure 4.4: Induction furnace (Image courtesy: otto-junker.com)

The basic principle of induction furnace is the induction heating. An induction furnace consists of a nonconductive crucible holding the charge of metal to be melted, surrounded by a coil of copper wire. A powerful alternating current flows through the wire. The coil creates a rapidly reversing magnetic field that penetrates the metal. The magnetic field induces eddy currents, circular electric currents, inside the metal, by electromagnetic induction. The eddy currents, flowing through the electrical resistance of the bulk metal, heat it by Joule heating. In ferromagnetic materials like iron, the material may also be heated by magnetic hysteresis, the reversal of the molecular magnetic dipoles in the metal. Once melted, the eddy currents cause vigorous stirring of the melt, assuring good mixing. There are two main types of induction furnace: coreless and channel.

The heart of the coreless induction furnace is the coil, which consists of a hollow section of heavy duty, high conductivity copper tubing which is wound into a helical coil. Coil shape is contained within a steel shell and magnetic shielding is used to prevent heating of the supporting shell. To protect it from overheating, the coil is water-cooled, the water being re-circulated and cooled in a cooling tower. The shell is supported on trunnions to facilitate pouring

The channel induction furnace consists of a refractory lined steel shell which contains the molten metal. Attached to the steel shell and connected by a throat is an induction unit which

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forms the melting component of the furnace. The induction unit consists of an iron core in the form of a ring around which a primary induction coil is wound. This assembly forms a simple transformer in which the molten metal loops comprise the secondary component. The heat generated within the loop causes the metal to circulate into the main well of the furnace. The circulation of the molten metal effects a useful stirring action in the melt.

4.2 Existing Technologies in the Engineering Workshops of the Cluster

The engineering workshops of Jashore LE cluster manufacture a wide variety of products. Interestingly, they are doing these using very old-fashioned and conventional machine tools. Most of the machines are very old and don't possess the necessary tools for high-precision manufacturing. However, the workers and supervisors in this cluster are skilled enough to get the most out of these machines. The most commonly used machines and technologies in this cluster are presented in this section.

4.2.1 Conventional Lathe Machine

Machining is one of the most important material removal methods in the technology of manufacturing. It is basically a collection of material working processes that involves other processes such as drilling, shaping, sawing, planning, reaming, and grinding among others.

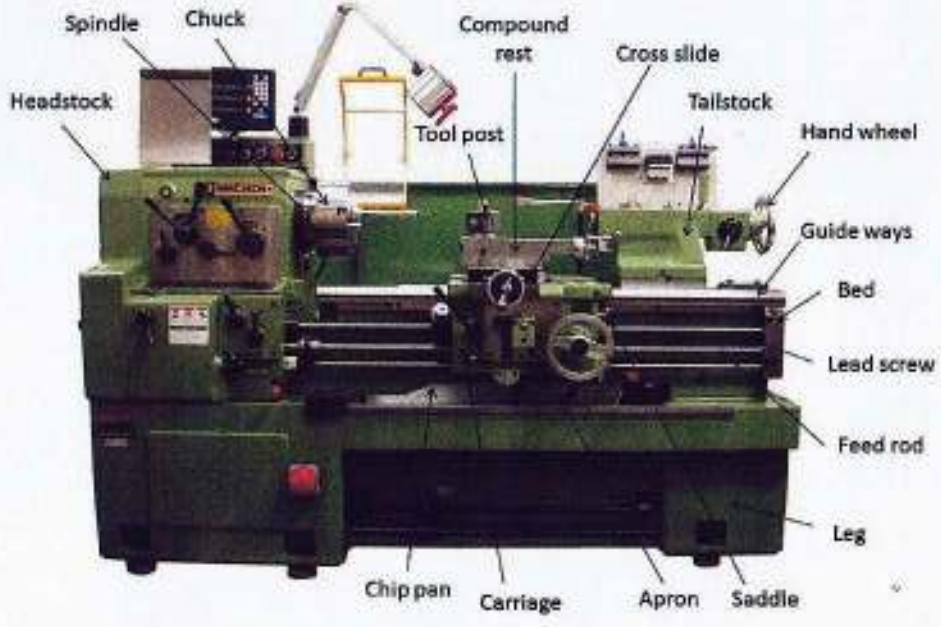

Figure 4.5: Lathe machine (Image Courtesy: mech4study.com)

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4.2.2 Conventional Milling Machine

The milling machines are also known as the multi-tasking machines (MTMs) which are multi-purpose machines capable of milling and turning the materials as well. The milling machine has got the cutter installed up on it which helps in removing the material from the surface of the work piece. When the material gets cooled down then it is removed from the milling machine.

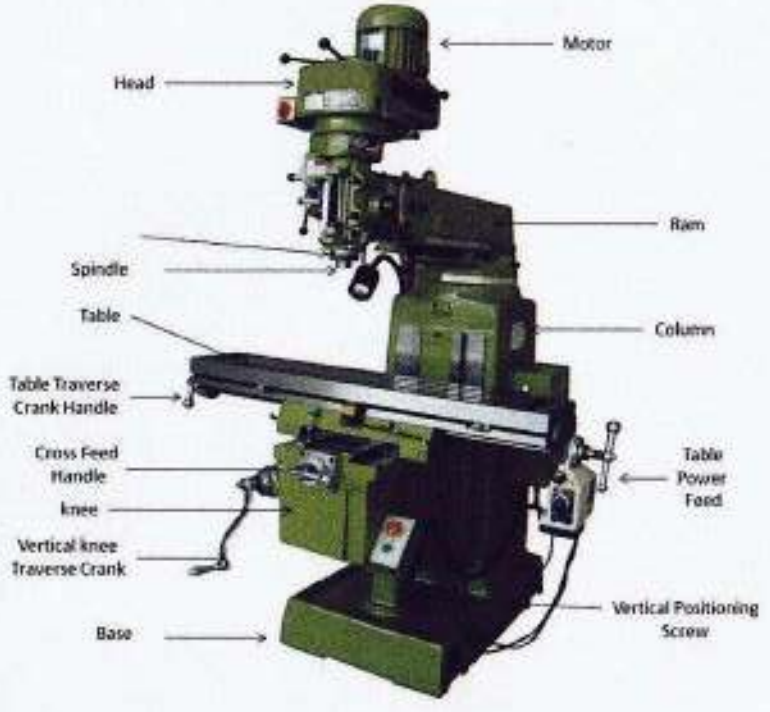

Figure 4.6: Milling machine (Image Courtesy: mech4study.com)

4.2.3 Drilling Machine

The drilling machine or drill press is one of the most common and useful machine employed in industry for producing forming and finishing holes in a work piece. The unit essentially consists of a spindle which turns the tool (called drill) which can be advanced in the work piece either automatically or by hand and a work table which holds the work piece rigidly in position. The rotating edge of the drill exerts a large force on the work piece and the hole is generated. The removal of metal in a drilling operation is by shearing and extrusion.

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Figure 4.7: Drilling machine (Image Courtesy: mech4study.com)

4.2.4 Shaper Machine

The shaper machine is a reciprocating type of machine basically used for producing the horizontal, vertical or flat surfaces. The shaper holds the single point cutting tool in ram and work piece is fixed in the table.

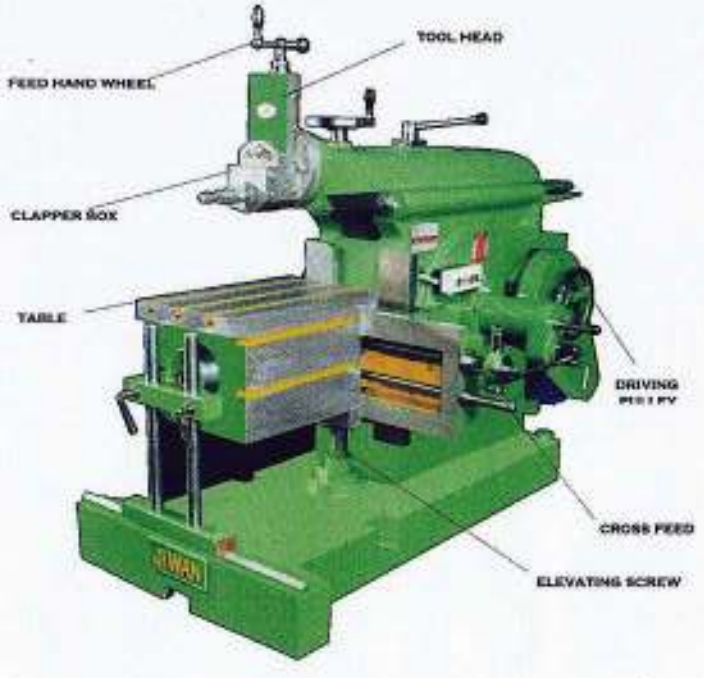

Figure 4.8: Shaper Machine (Image Courtesy: mech4study.com)

During the forward stroke, the ram is holding the tool is reciprocating over the work piece to cut into the required shape. During the return stroke, No metal is cutting. In the shaper

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machine, the rotary motion of the drive is converted into reciprocating motion of ram holding the tool.

4.3 Heat Treatment of Ferrous Metal

In Jashore LE cluster, the foundries that manufacture MS and CI products utilize different heat treatment processes. Also, some engineering workshops take the advantage of heat treatment, although the number of workshops doing so is very few. All heat-treating operations involve the heating and cooling of metals. The common forms of heat treatment for ferrous metals used in this cluster are annealing, normalizing, hardening, tempering, and case hardening.

4.3.1 Annealing

Metals are annealed to relieve internal stresses, soften them, make them more ductile, and refine their grain structures. Metal is annealed by heating it to a prescribed temperature, holding it at that temperature for the required time, and then cooling it back to room temperature. The rate at which metal is cooled from the annealing temperature varies greatly. Steel must be cooled very slowly to produce maximum softness, This can be done by burying the hot part in sand, ashes, or some other substance that does not conduct heat readily (packing), or by shutting off the furnace and allowing the furnace and part to cool together (furnace cooling).

4.3.2 Normalizing

Ferrous metals are normalized to relieve the internal stresses produced by machining, forging, or welding. Normalized steels are harder and stronger than annealed steels. Steel is much tougher in the normalized condition than in any other condition. Parts that will be subjected to impact and parts that require maximum toughness and resistance to external stresses are usually normalized. Normalizing prior to hardening is beneficial in obtaining the desired hardness, provided the hardening operation is performed correctly. Low carbon steels do not usually require normalizing, but no harmful effects result if these steels are normalized. Normalizing is achieved by heating the metal to a specified temperature (which is higher than

either the hardening or annealing temperatures), soaking the metal until it is uniformly heated, and cooling it in still air.

4.3.3 Hardening

A ferrous metal is normally hardened by heating the metal to the required temperature and then cooling it rapidly by plunging the hot metal into a quenching medium, such as oil, water, or brine. Most steels must be cooled rapidly to harden them. The hardening process increases the hardness and strength of metal, but also increases its brittleness.

4.3.4 Tempering

Steel is usually harder than necessary and too brittle for practical use after being hardened. Severe internal stresses are set up during the rapid cooling of the metal. Steel is tempered after being hardened to relieve the internal stresses and reduce its brittleness. Tempering consists of heating the metal to a specified temperature and then permitting the metal to cool. The rate of cooling usually has no effect on the metal structure during tempering. Therefore, the metal is usually permitted to cool in still air. Temperatures used for tempering are normally much lower than the hardening temperatures. The higher the tempering temperature used, the softer the metal becomes. High-speed steel is one of the few metals that becomes harder instead of softer after it is tempered.

4.3.5 Case Hardening

Case hardening is an ideal heat treatment for parts which require a wear-resistant surface and a tough core, such as gears, cams, cylinder sleeves, and so forth. The most common case-hardening processes are carburizing and nitriding. During the case-hardening process, a low-carbon steel (either straight carbon steel or low-carbon alloy steel) is heated to a specific temperature in the presence of a material (solid, liquid, or gas) which decomposes and deposits more carbon into the surface of a steel. Then, when the part is cooled rapidly, the outer surface or case becomes hard, leaving the, inside of the piece soft but very tough.

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4.4 Process Flow Diagram

4.4.1 Foundry

All the foundries operating in Jashore Light Engineering Cluster are using sand casting process. This is a very economical process and requires comparatively less costly setup. Also, this process is very suitable when a wide variety of products are to be manufactured in the same industry, which is the case for foundries in Jashore. The typical process flow diagram of sand casting is presented in Figure 4.9.

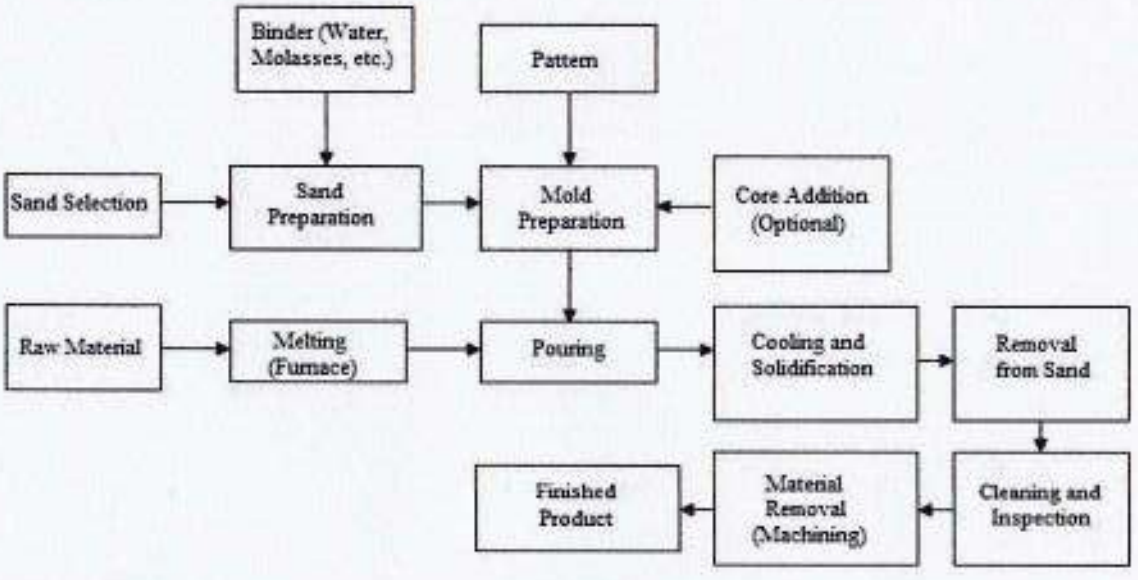

Figure 4.9: Process Flow Diagram for Sand Casting

4.4.2 Engineering Workshop

Most of the engineering workshops operating in the Jashore Light Engineering Cluster are either repairing or manufacturing automobile parts. Some other types of products such as agricultural products, textile mill machineries, etc. are also manufactured in these workshops. Every product has a distinct process flow diagram. As a result, it is not feasible to present all of them in a single report. The typical process flow diagram for manufacturing gear and crankshaft are presented in Figure 4.10 and Figure 4.11 respectively.

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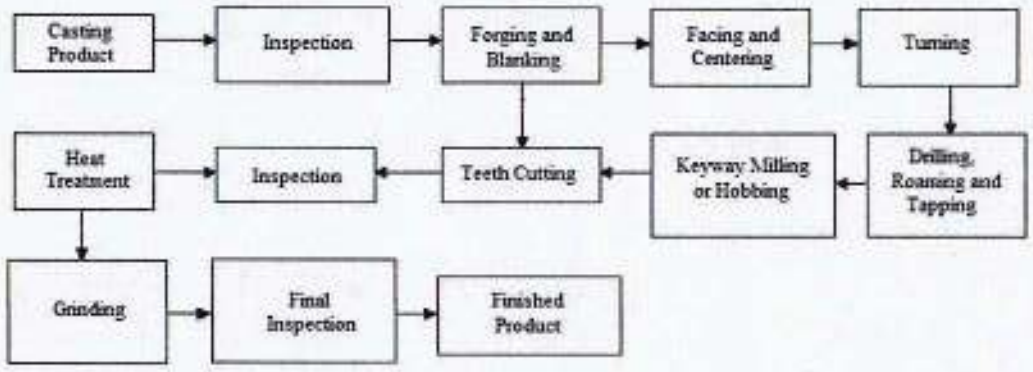

Figure 4.10: Process Flow Diagram for Gear Manufacturing

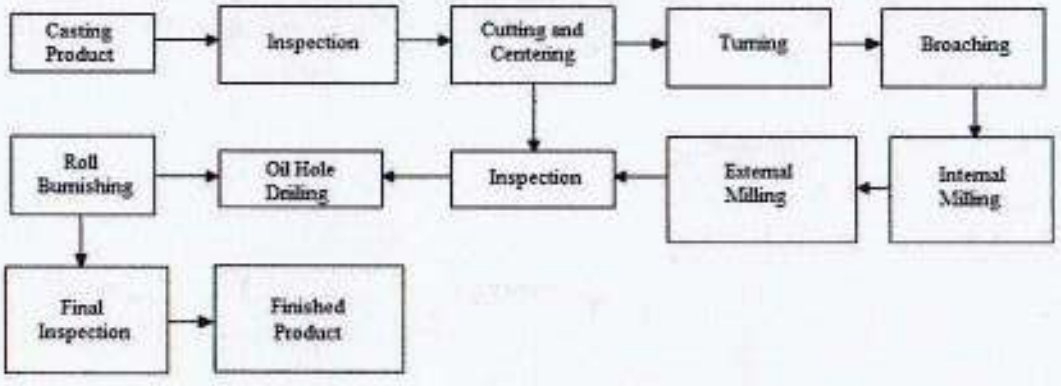

Figure 4.11: Process Flow Diagram for Crankshaft Manufacturing

4.5 Comparison with More Advanced Technologies

The technologies used in the foundry industries have not changed much over time. The conventional sand casting process is still widely used all around the world for a variety of product shapes and sizes. This technology is also the most suitable one for cast iron and mild steel products. However, there is better option for plastic and aluminum casting; pressure die casting.

Pressure die casting is far better than sand casting process when the production volume is high and good finishing of the product is required. In the foundries where aluminum products are cast, injection molding may be introduces. Figure 5.12 shows pressure die casting process.

For some mild steel and cast iron products, centrifugal casting may be adopted. This casting process is very useful when the product to be cast is of circular or cylindrical shape. For pipe manufacturing, this is the best option. Figure 5.13 shows centrifugal casting process.

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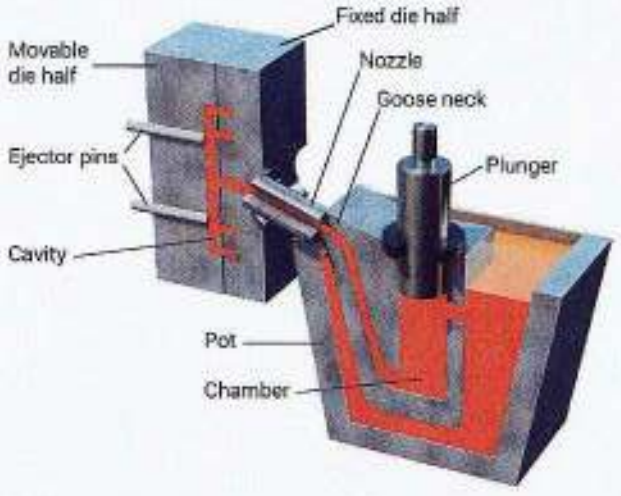

Figure 4.12: Pressure Die Casting (Image Courtesy: engineeringclicks.com)

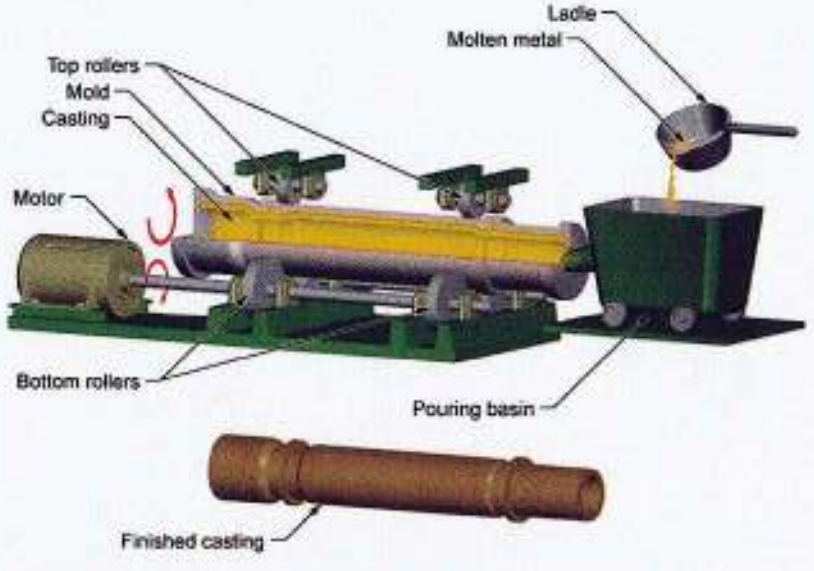

Figure 4.13: Centrifugal Casting (Image Courtesy: custompartnet.com)

For higher quality work pieces and automobile parts, squeeze casting can be adopted. Squeeze casting is the combination of casting and forging process. This process is very economical and has the ability of mass production with simple process parameter control. Figure 4.14 shows squeeze casting process.

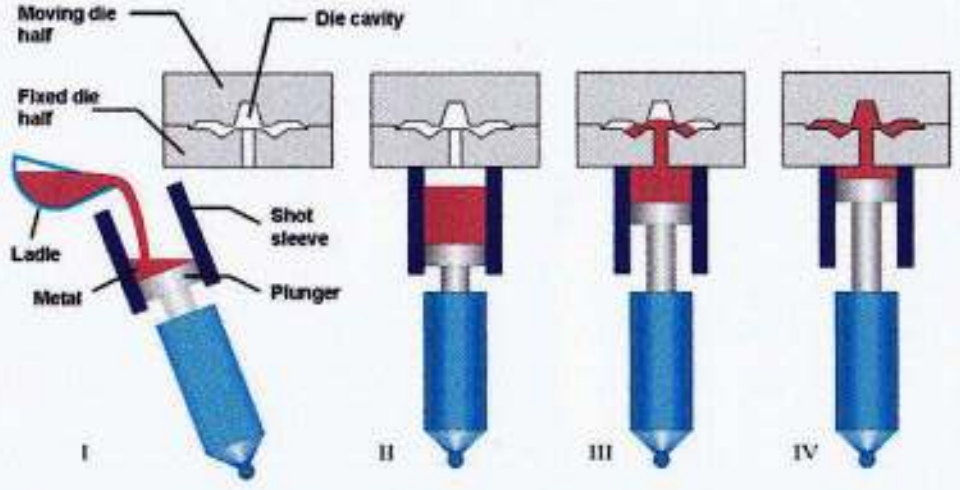

Figure 4.14: Squeeze Casting (Image courtesy: metals-china.com)

In case of machining industries in this cluster, the technologies used are very old-fashioned and are becoming obsolete in many developing and developed countries. In many countries such as India, China, Taiwan, Germany, Switzerland, USA, etc. traditional manual machines have been partially or completely replaced by automatic, semi-automatic and CNC machine tools. These more advanced machine tools are necessary for larger production volume and economical production.

It is to be noted that some confuse automatic machine tool with CNC machine tool. This is, in fact, not the case. Automatic machine tools are those which operate automatically with the help of mechanical constraints and require no human intervention once started. Human intervention is only required for material loading and unloading. For semi-automatic, however, human intervention is required after each product is finished machining. Automatic machine tools are useful for large production volume while semi-automatic is useful for comparatively smaller production volume. The disadvantage of these two machine tools is that they are usually set-up for producing only a few types of products. For manufacturing large variety of products, they are not that much suitable. Figure 4.15 and Figure 4.16 show automatic and semi-automatic lathes respectively.

In case of CNC machine tools, all the control mechanisms are computerized, making them even more accurate. Also, the programming can be changed to manufacture a large variety of products. However, they are extremely costly. Figure 4.17 shows a typical CNC milling machine.

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Figure 4.15: Automatic Lathe Machine (Image Courtesy: machinemfg.com)

Figure 4.16: Semi-Automatic Lathe Machine (Image courtesy: connect2india.com)

Figure 4.17: A Typical CNC Machine (Image courtesy: stylecnc.com)

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There is also use of CNC machine tools in foundry industry, for pattern making. Accurate pattern making is necessary for manufacturing high quality and precise products from molding. This is why CNC machine is extensively in developed country for pattern making. 3D printer is another option for precise pattern making. 3D printing utilizes CAD design coordinates to produce metal or plastic 3D object using additive manufacturing.

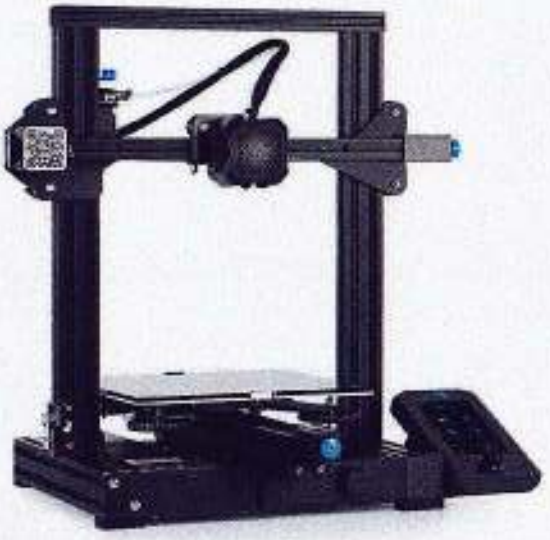

Figure 4.18: A Typical 3D Printer (Image courtesy: powerplanetonline.com)

Finally, for reverse engineering, Coordinate Measuring Machine (CMM) is an essential technology. This machine is used to generate accurate 3D CAD design by measuring the coordinates of an existing product. This CAD design may be imported in a CNC or 3D Printer to replicate the product on any quantity. China has and is extensively using this technology.

Figure 4.19: A Typical Coordinate Measuring Machine (CMM) (Image courtesy: http://brahmaniwebtechindustries.com)

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Besides using cast iron, the use of ductile iron can be introduced in the cluster. Ductile iron can be bent without breaking whereas cast iron cast iron is brittle and breaks when bent. Ductile iron products have more strength and corrosion resistance than gray iron. Therefore, this ductile iron can be used in the production of automobile parts, wheels, gear boxes, pipe and other machine parts.

Figure 4.20: Ductile Iron Casting Part (metals-foundry.com)

CHAPTER 5

SKILL AND TECHNOLOGY GAP ANALYSIS

5.1 Findings from Field Survey

The field survey was conducted for 11 weeks, starting from 1st December, 2019 and ending on 15th February, 2020. A total of 193 industries were surveyed; among them 15 were foundries and 178 were engineering workshops. A total of 223 persons were interviewed; among them 181 were owners, 12 were supervisors or managers and 30 were workers.

The foundries located in this cluster have three types of furnaces; Induction Coil Furnace, Cupola Furnace and Crucible Furnace. Figure 5.1 shows the furnaces used in this cluster and their quantities. The induction furnaces are mainly for production of mild steel products. The products are usually automobile parts, gears, shafts, pinions, propellers, pipe fittings, etc. These furnaces are all imported from India except the one used in Firoz Metal which is locally manufactured. All the induction furnaces used in this region have capacity of 1.5 Tons. The cupola furnaces are for used for cast iron products such as tube-wells, pump casings, etc. These furnaces are all locally manufactured. Four of the furnaces are of 10 Tons capacity while two are of 3 Tons capacity. Finally, the crucibles are used for casting Aluminum products. One foundry produces aluminum accessories while two foundries make aluminum patterns using these furnaces. All the foundries employ sand casting. Only Adiba Metal has attempted to make a pressure die casting machine locally (spent around 5 lacs). However, the attempt was unsuccessful.

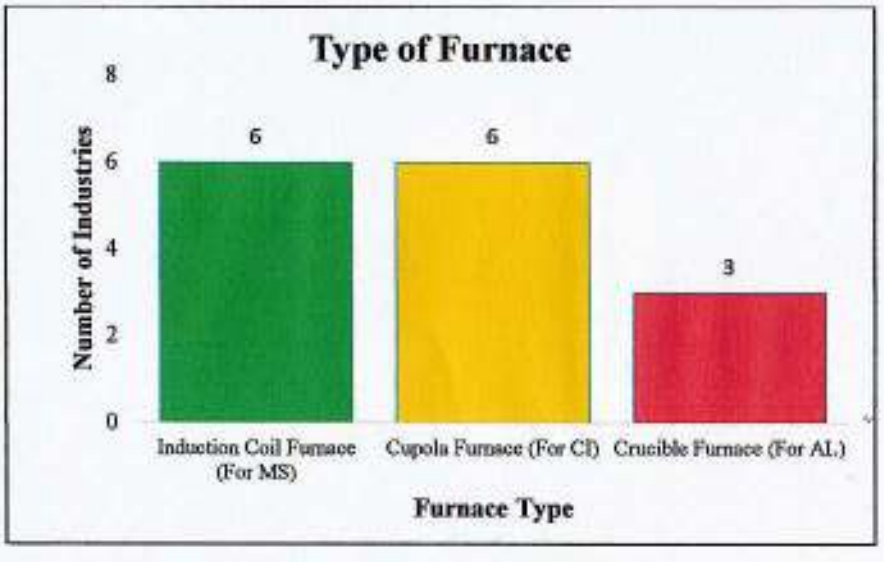

Figure 5.1: Type of Furnaces used in Jashore cluster.

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A total of 856 workers are working in this sector, of which 63 are female, as shown in Figure 5.2. These female workers are mostly engaged in cleaning and other light works. Figure 5.3 shows the number of workers in each industry. From Figure 5.3, it may be observed that most foundries have workers between the range 31 to 120 persons. Most of the workers are highly skilled. Majority of them can teach others while some can only work. The skill matrix of the workers in the foundry section is shown in Figure 5.4. From skill matrix, it may be observed that only 19% of the total workers can't do the tasks or can do but with help. The low number indicates that most of the workers are old ones and ne workforce is not available in this sector. As a result, the fraction of unskilled persons is low.

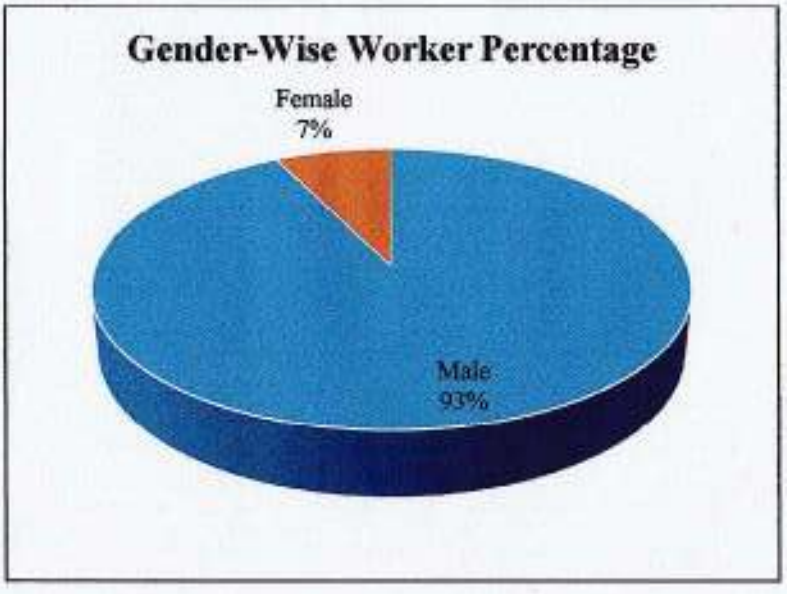

Figure 5.2: Worker male-female ratio analysis (for foundry industry only)

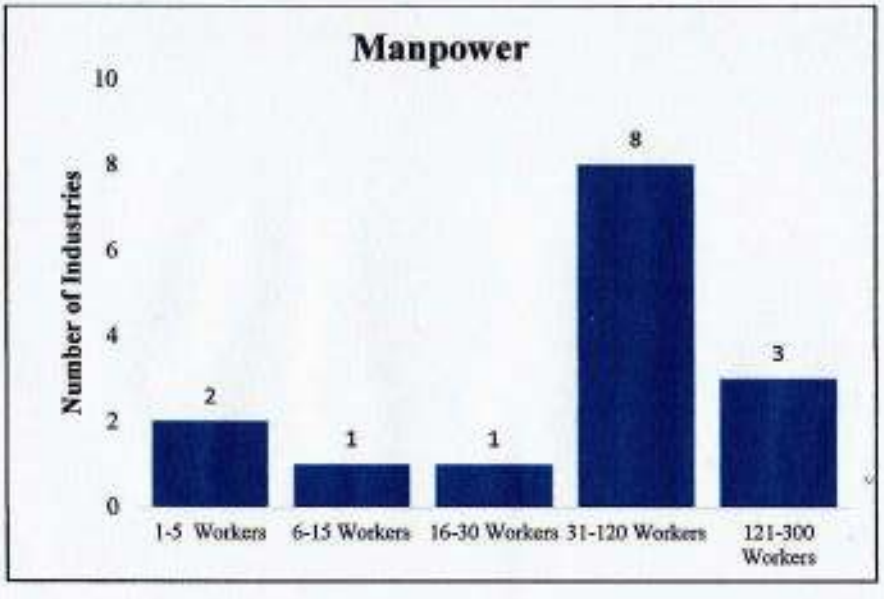

Figure 5.3: Number of workers in each foundry industry.

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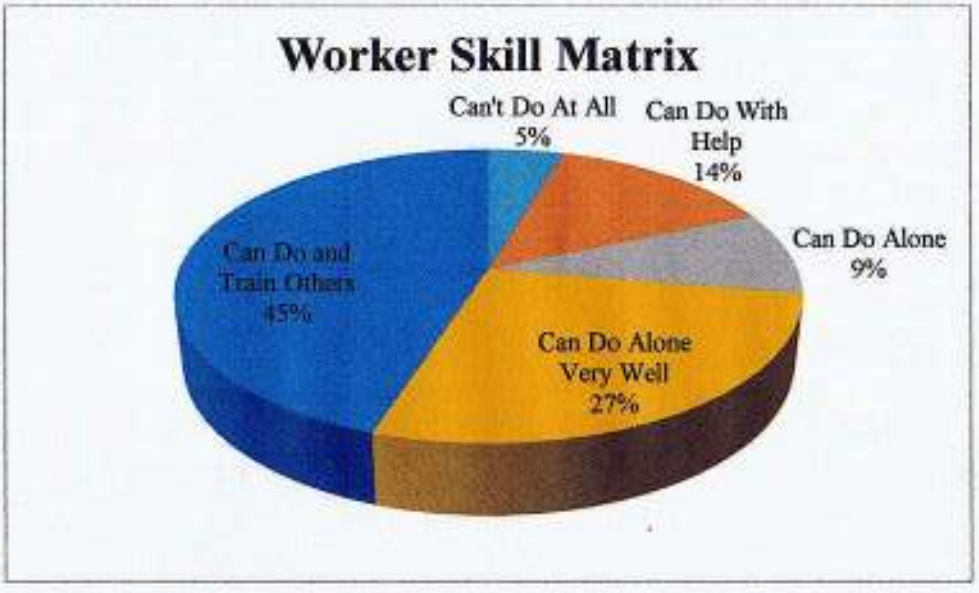

Figure 5.4: Worker skill matrix (for foundry industry only)

Among the 15 foundries studied in this work, only 3 have their own testing facilities. Ripon metal and Wosa foundry have chemical composition testing facilities while Sreeza Metal and Foundry has both chemical and mechanical property testing facilities. Others are dependent on BUET and KUET for testing reports.

In case of engineering workshops, there are varieties of products manufactured or services provided. Figure 5.5 shows the products and services provided by engineering workshops of Jashore LE cluster. From Figure 5.5, it may be observed that most of the workshops are doing automobile parts repairing work rather than manufacturing any parts. Among the manufactured machines, agricultural machineries are manufactured the most.

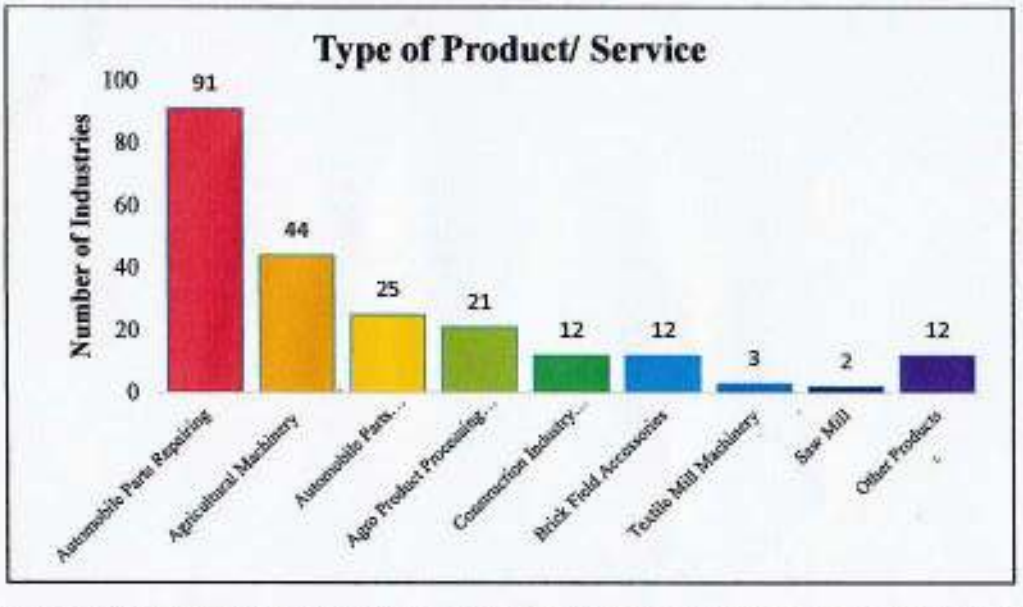

Figure 5.5: Type of products produced or services provided in the workshops of Jashore LE clusters.

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There are 1179 workers working in this sector. Only 6 are female. The male to female worker ratio is quite lower than that observed for foundry industry, as shown in Fig.6. The reason behind this low ratio is the risky and harsh nature of the jobs performed in this sector, which is not favorable for female workers. Most of the engineering workshops have less than 6 workers, as shown in Figure 5.7. However, only one engineering workshop has workers more than 30.

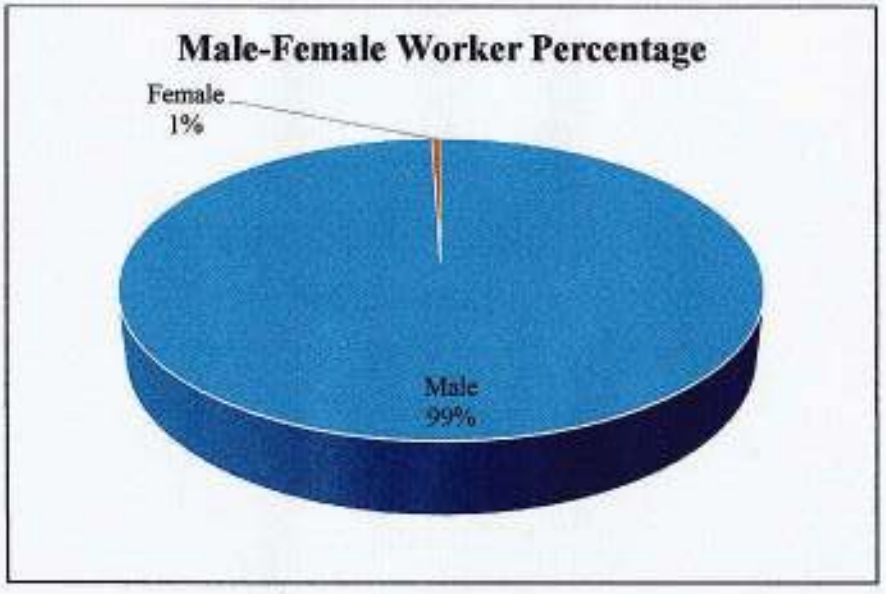

Figure 5.6: Worker male-female ratio analysis (for engineering workshops only)

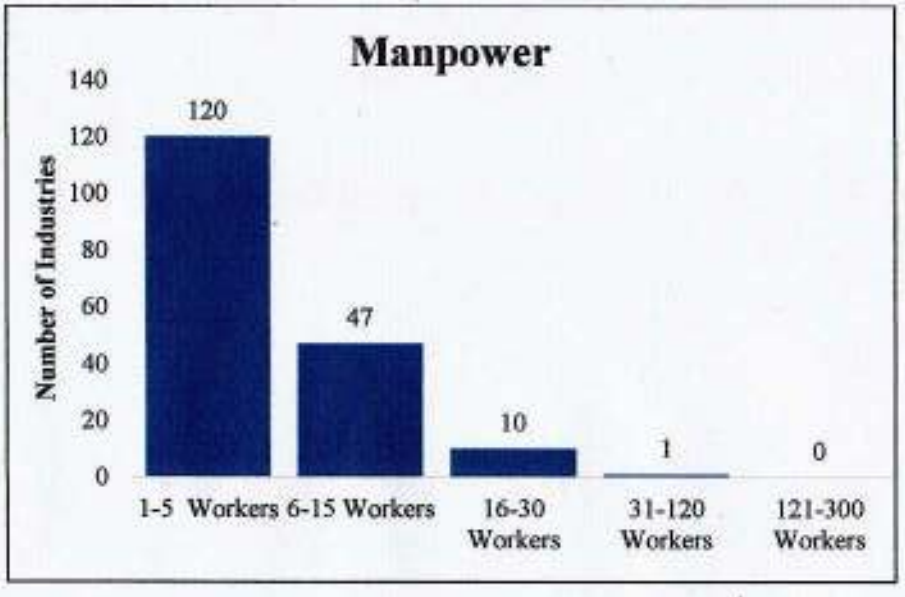

Figure 5.7: Number of workers in each engineering workshop.

Most of the workers of these engineering workshops are extremely skilled in operating conventional machine tools, as shown in Figure 5.8. However, this is rather alarming since this indicates lack of new workforce. From the skill matrix, it may be observed that only 5%

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of total workforce is apparently new ones. This implies workers are less attracted towards this sector.

One of the greatest drawbacks of these workers is that they are not well-educated. As a result, they are not accustomed to using different measuring devices; rather they do the measurements through idea and experience. This is why the product accuracy is not up to the mark. Nevertheless, the workers are very skilled in operating conventional machine tools.

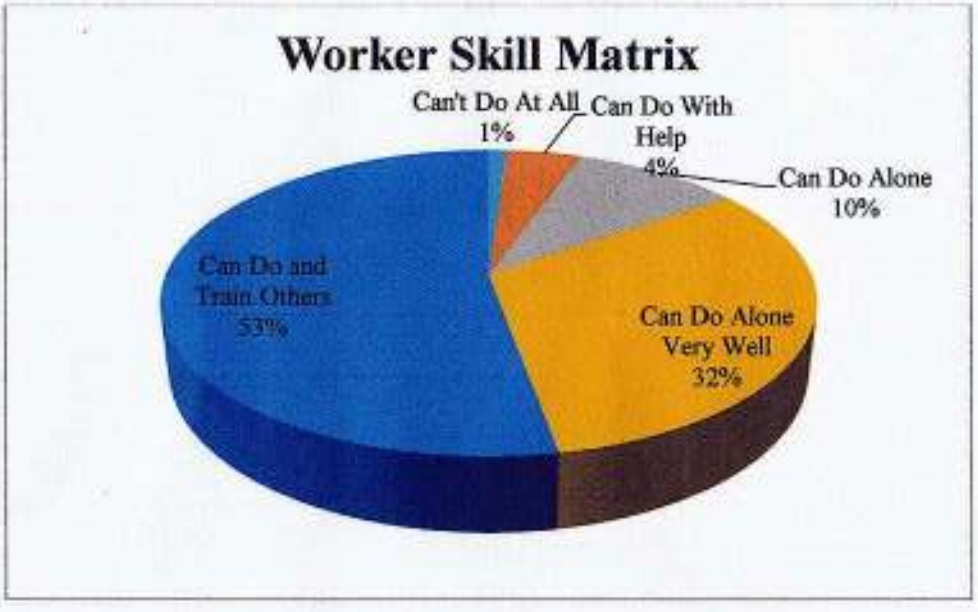

Figure 5.8: Worker skill matrix (for engineering workshops only)

A large variety of machines are used in the engineering workshops of Jashore LE cluster. These machines are conventional and manual ones. The most common types of machines used in the workshops are shown in Figure 5.9. Most of the engineering workshops have less than 6 machines, as shown in Figure 5.10.

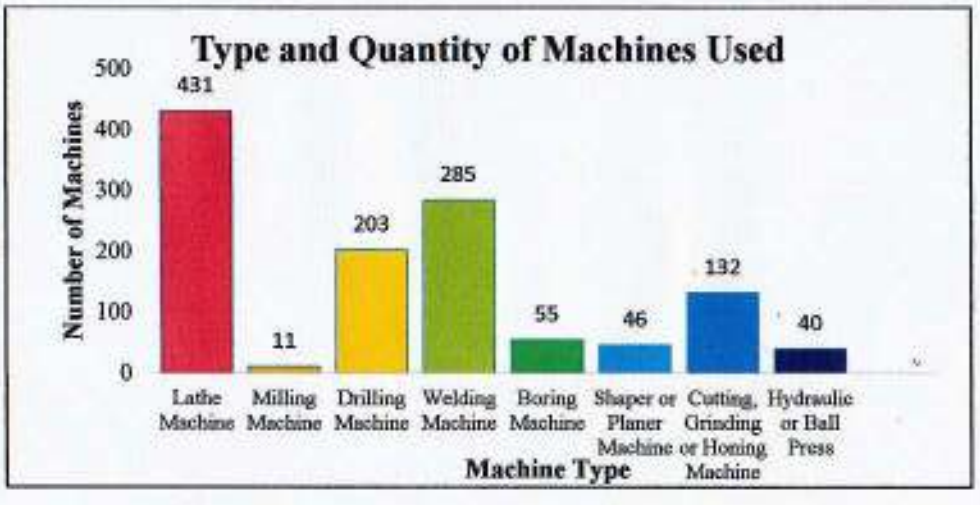

Figure 5.9: Types of machines used in engineering workshops.

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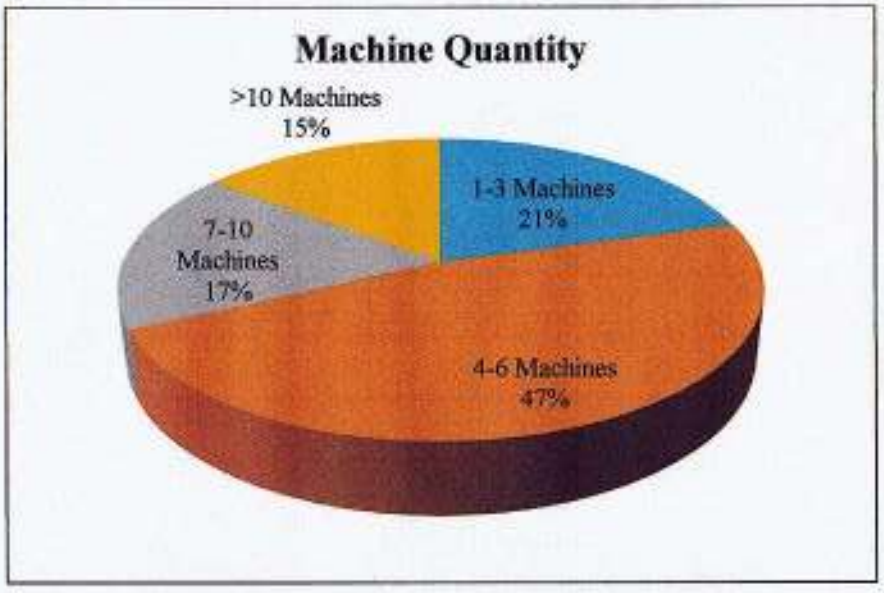

Figure 5.10: Number of machines in each engineering workshop.

Figure 5.11 to Figure 5.18 shows the country of origin of each machines used in these workshops. From Figure 5.11, it may be observed that around 23% of the lathe machines in this cluster are locally manufactured. Three engineering workshops are making lathe machines locally in Jashore. However, the users of these locally-made lathe machines have stated that these lathe machines are inferior to Indian and Chinese lathe machines in quality. Nevertheless, they are lower in price than foreign machines and thus are preferred by many who are opening new business.

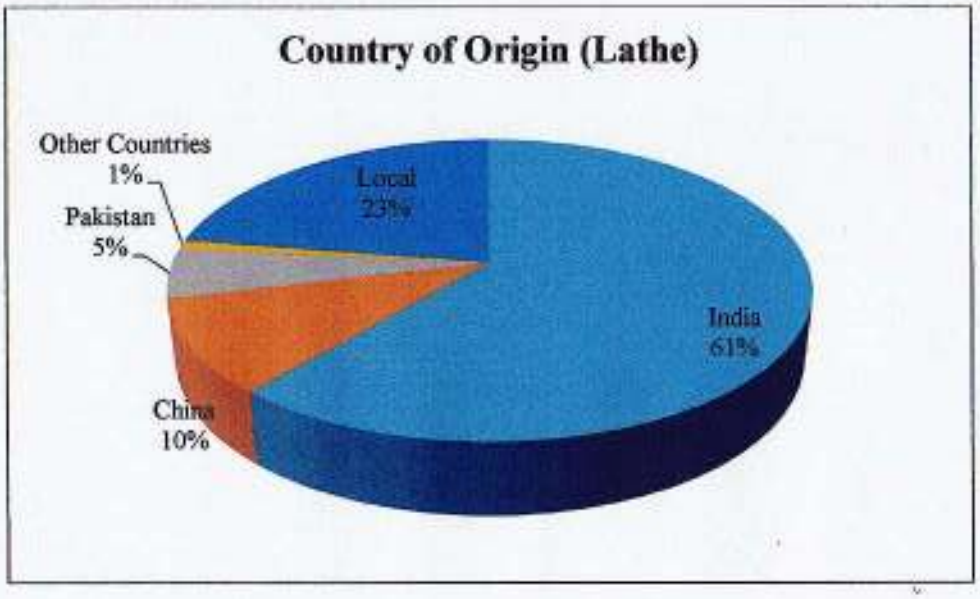

Figure 5.11: Country of origin (lathe machine)

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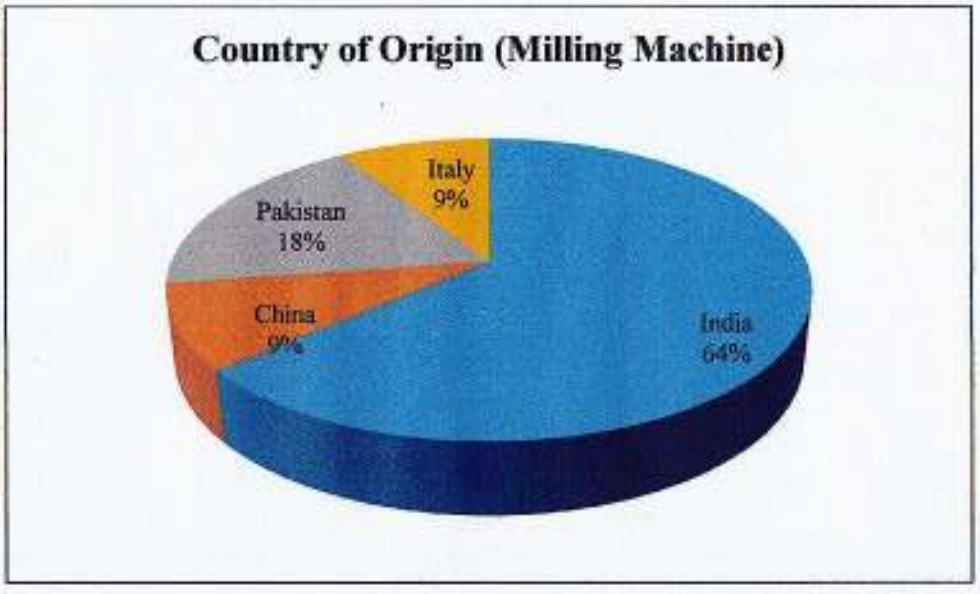

Figure 5.12: Country of origin (Milling Machine)

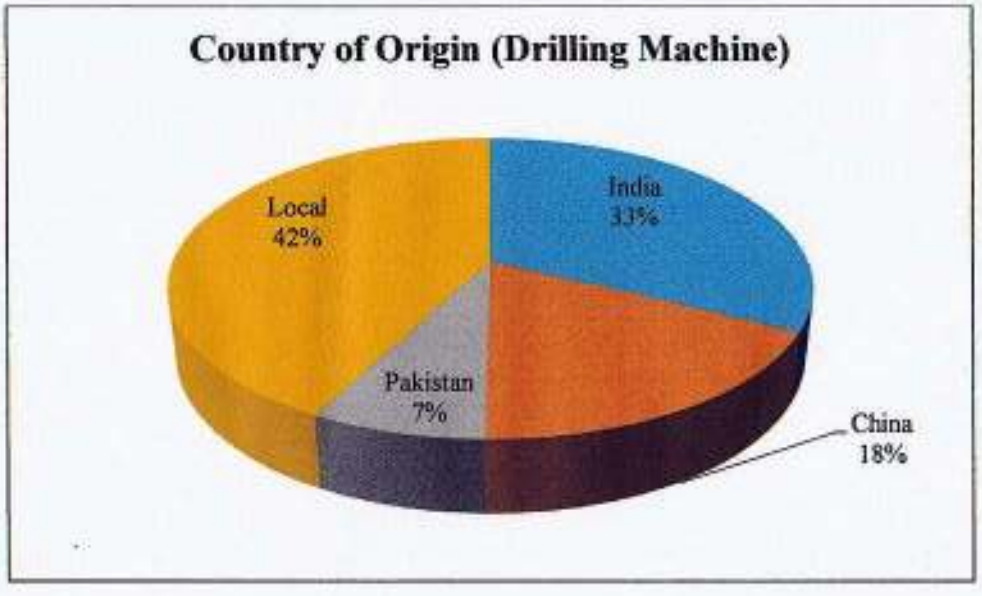

Figure 5.13: Country of origin (Drilling machine)

There are very few workshops that have milling machine. From Figure 5.13, it may be observed that the milling machines in this cluster are all imported. There is no local manufacturer of milling machine in this cluster. Indian milling machines are most common in this cluster (64%).

An interesting thing to observe from Figure 5.14 is that most of the drilling machines used by the engineering workshops in this cluster are supplied by local manufacturers (42%). This is because of the simple construction of a drilling machine. Indian machines are also very common (33%).

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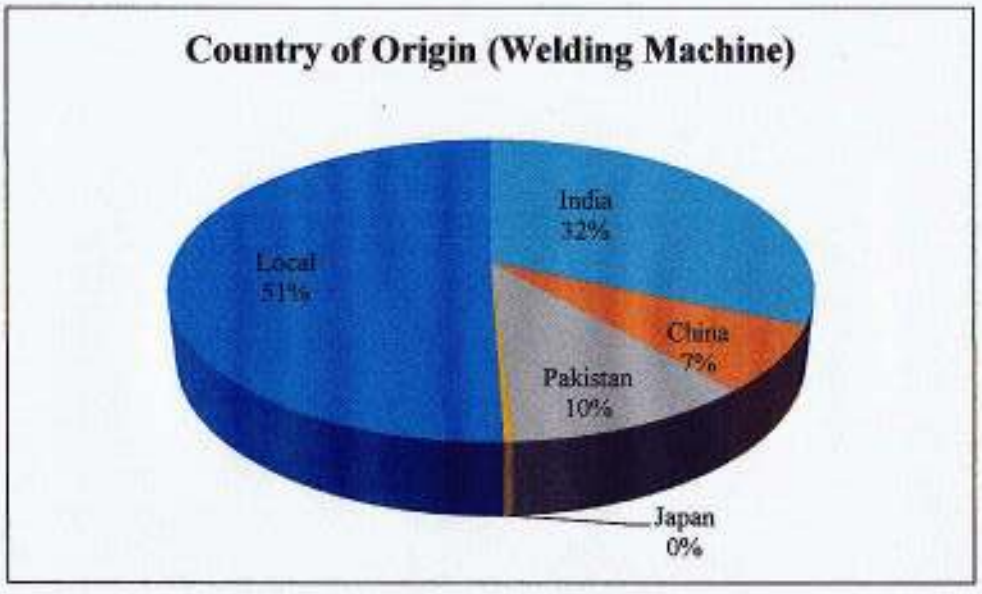

Figure 5.14: Country of origin (Welding machine)

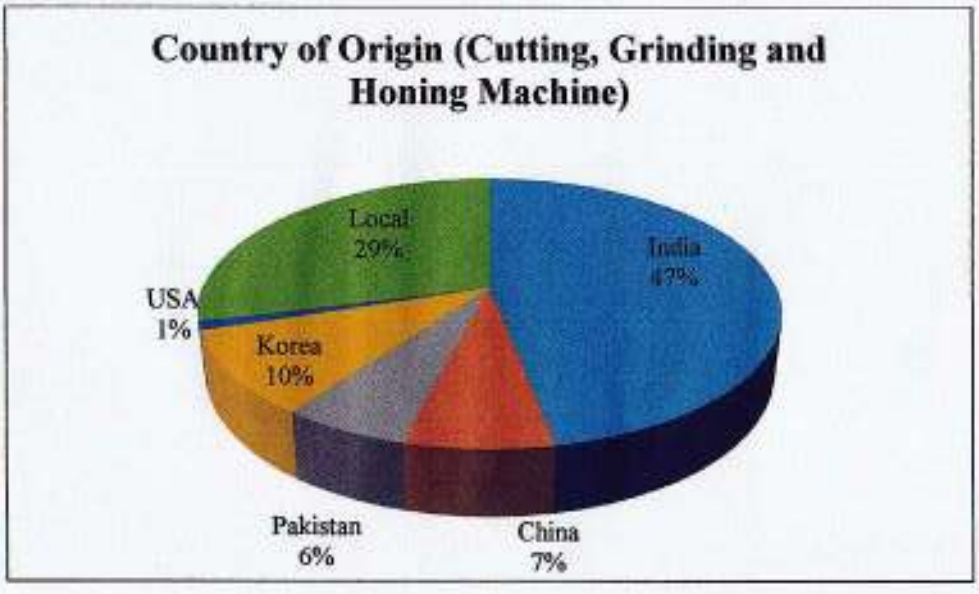

Figure 5.15: Country of origin (cutting, grinding and honing machine)

Most of the welding machines in the engineering workshops of this cluster are also locally made (51%). This may be observed in Figure 5.15. This machine has a very simple working principle and construction like drilling machine. Indian machines are also quite popular due to their low price (32%).

There are some engineering workshops that are using local cutting and grinding machines (29%). However, Indian machines are the most common ones (47%).

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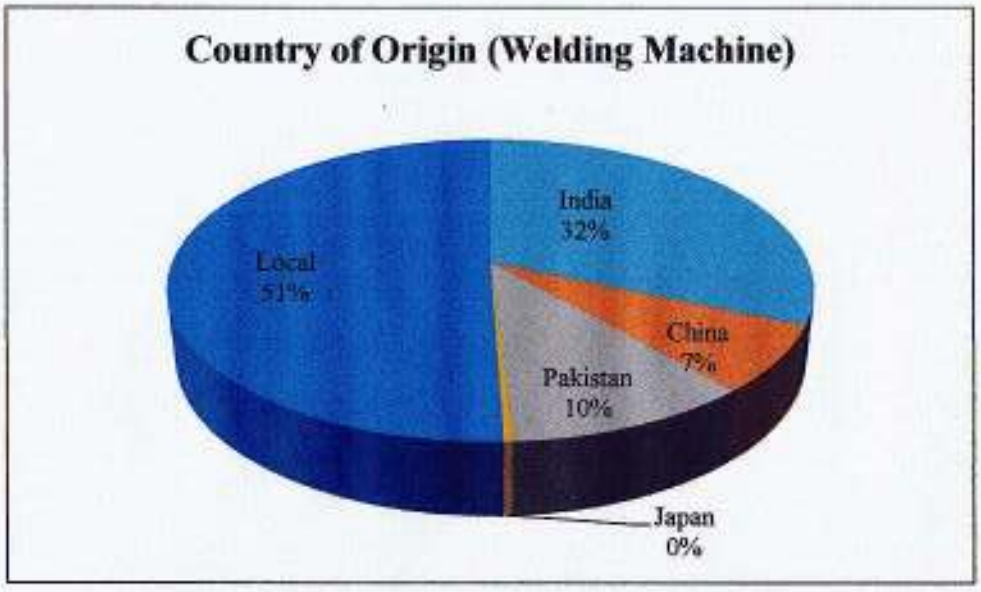
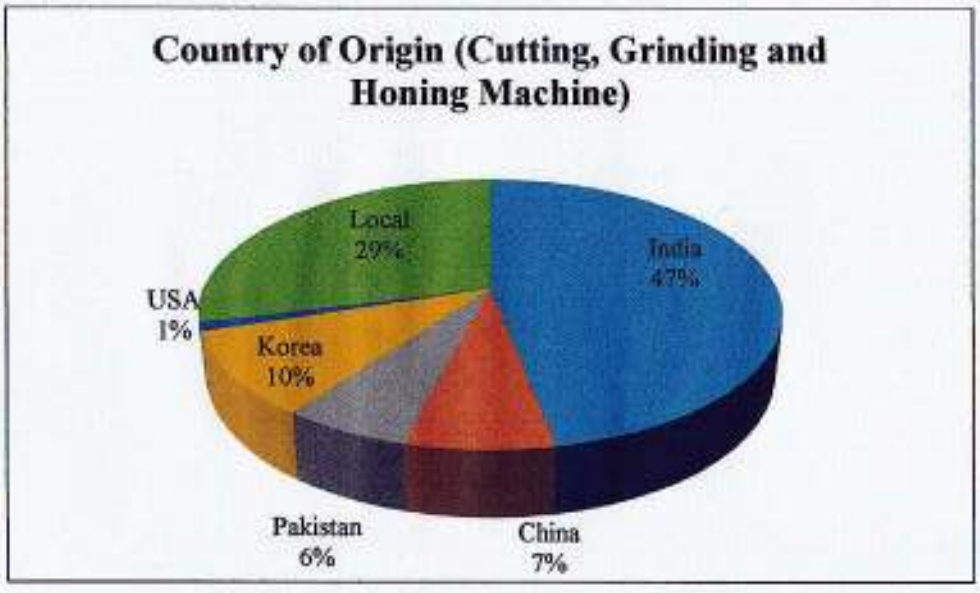


Figure 5.14: Country of origin (Welding machine)



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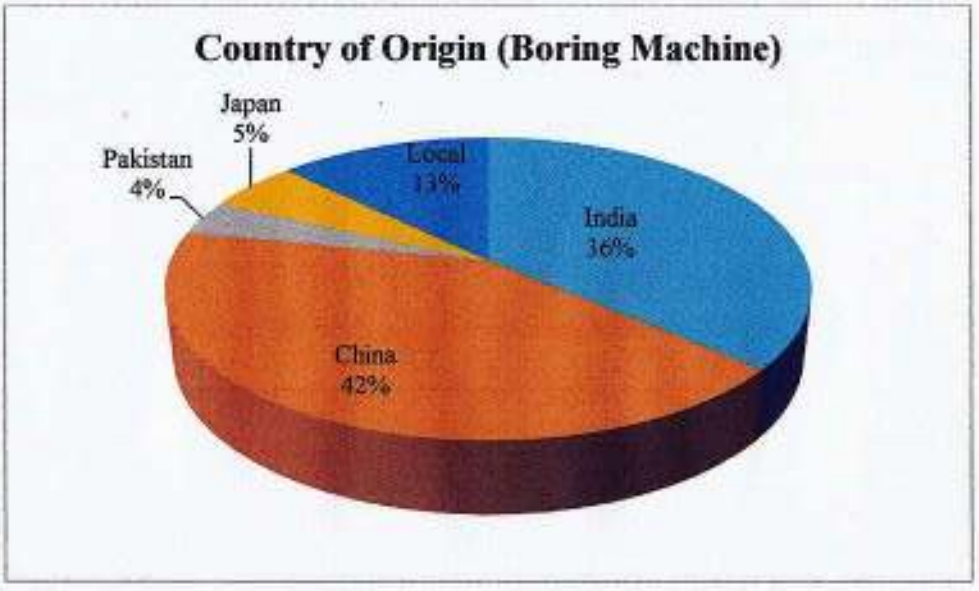

Figure 5.16: Country of origin (boring machine)

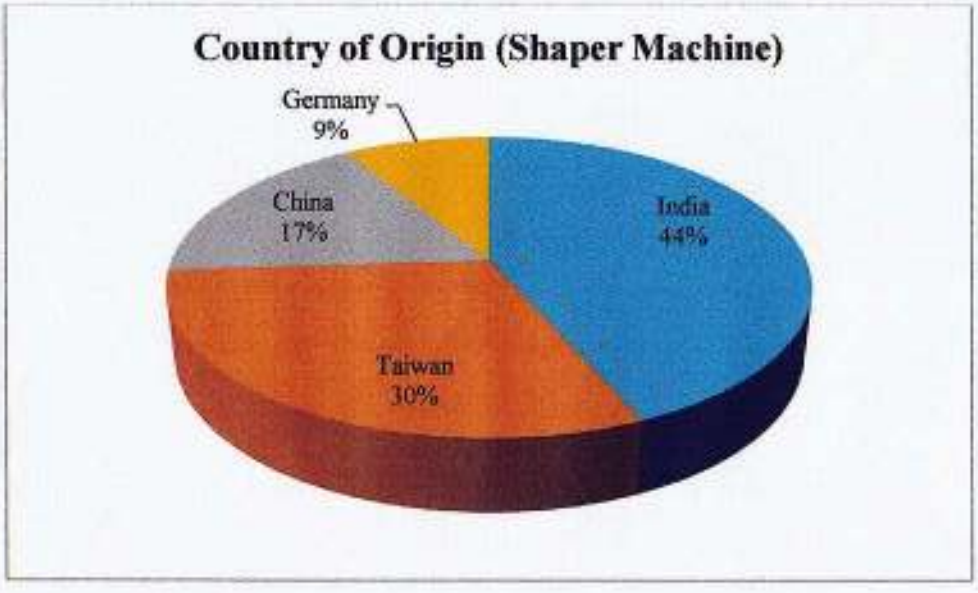

Figure 5.17: Country of origin (shaper machine)

Interestingly, Most of the boring machines are made in China (42%). However, these machines are beating Indian machines in a very small margin (32%). Some are using local machines too (13%). In case of shaper machine, there is no local manufacturer. Indian machines are dominating the cluster (44%). However, many choose machines from Taiwan due to their better accuracy and longevity (30%). Chinese machines are also seen in the cluster (17%). Finally, most of the power presses present in this cluster are locally manufactured (61%). Indian presses are also there (31%). From Figure 5.11 to 5.18, it may be observed that a large portion of the machines used in the engineering workshops are locally manufactured. This is good for our economy since this is saving foreign currency. With proper planning and initiative, local machine tools manufacturing may flourish in this cluster.

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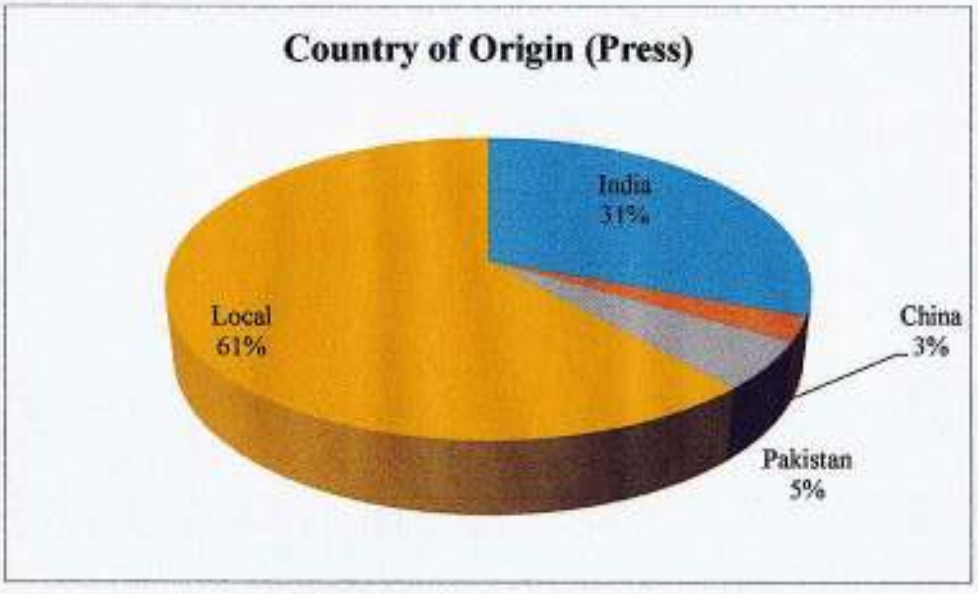

Figure 5.18: Country of origin (hydraulic press and ball press)

Figure 5.19 presents the workforce category of the foundry and engineering workshops of Jashore Light Engineering Cluster. However, from Figure 5.19, it may be observed that some industries are taking help from foreign consultants, though the number of industries doing so is very small. Only 6 industries, all of which are foundries, have taken help and opinion from foreign consultants for mainly two purposes; installation and maintenance of foundry machineries and quality improvement of products. However, these industry owners believe that local consultants are not efficient enough to help them in solving their problems. Only 2 local consultants are providing service in this cluster.

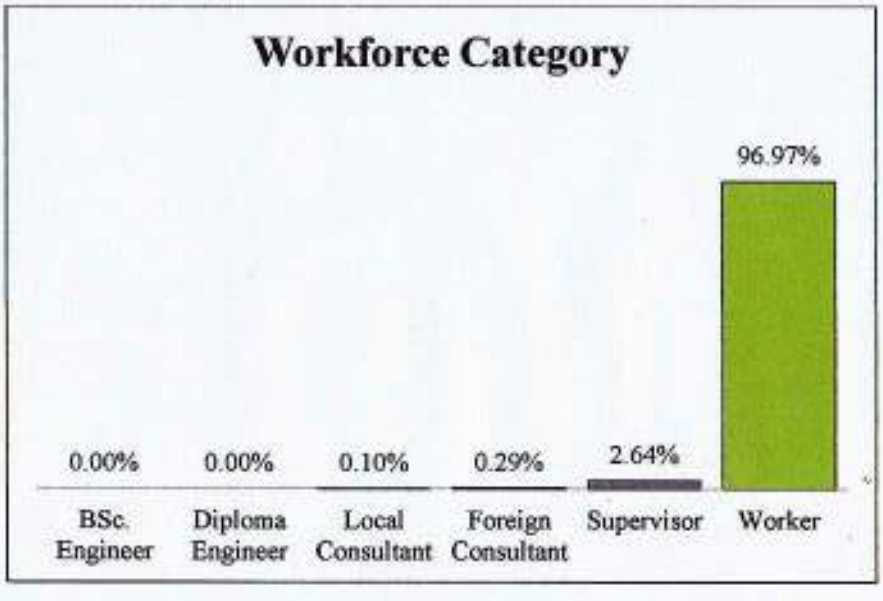

Figure 5.19: Workforce category in Jashore LE Cluster.

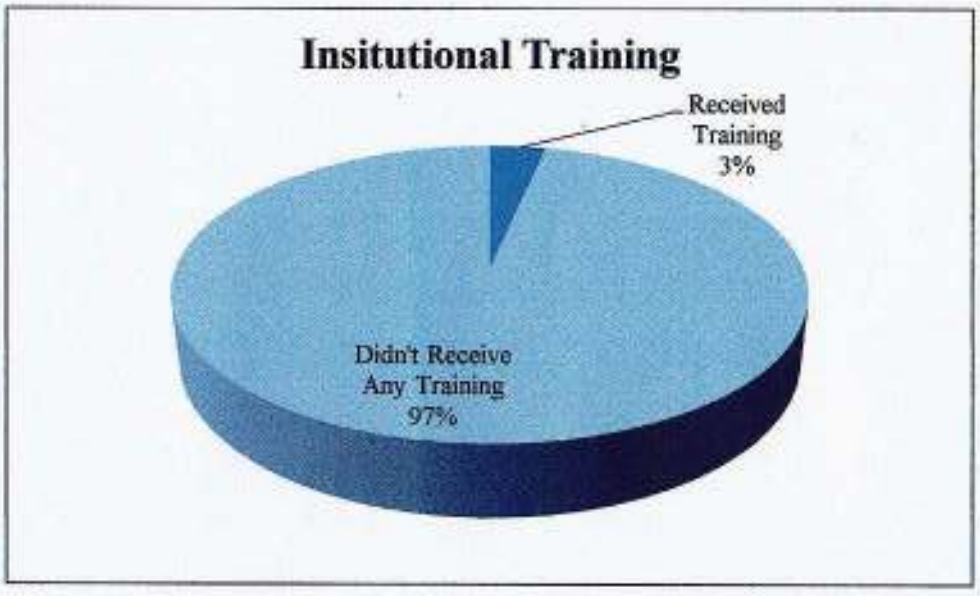

Figure 5.20: Institutional training of workforce in Jashore LE Cluster.

Crucial information regarding the workers of this cluster is that most of them haven't received any formal training from any institution, as shown in Figure 5.20. They have developed their machine operating skills through years of real-life experience. However, the industries whom have provided training to their workers have suggested that the trainings have, indeed, improved their skills in operating the machines. Nevertheless, most of the workers are unable to avail training due to time constraint as well as monetary issues.

Among all the persons interviewed, most of them believed that there is no quality testing is required to ensure quality of their product, as shown in Figure 5.21. This is because there is no engineer employed in these industries and they lack the knowledge on how product quality may be improved.

Figure 5.21: Mindset towards importance of quality testing.

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Also, most of them have no idea what the new improved machines can do. The situation is expressed in Figure 5.22. Again, all of them believe that there is no possibility of environment pollution from this sector (see Figure 5.23). This statement is partially true, since the waste of these foundries and workshops are again melted and recycled, thus effectively there is no waste. However, the foundries can still cause air pollution since the chemical composition of raw materials is unknown. On the other hand, the engineering workshops can cause noise pollution.

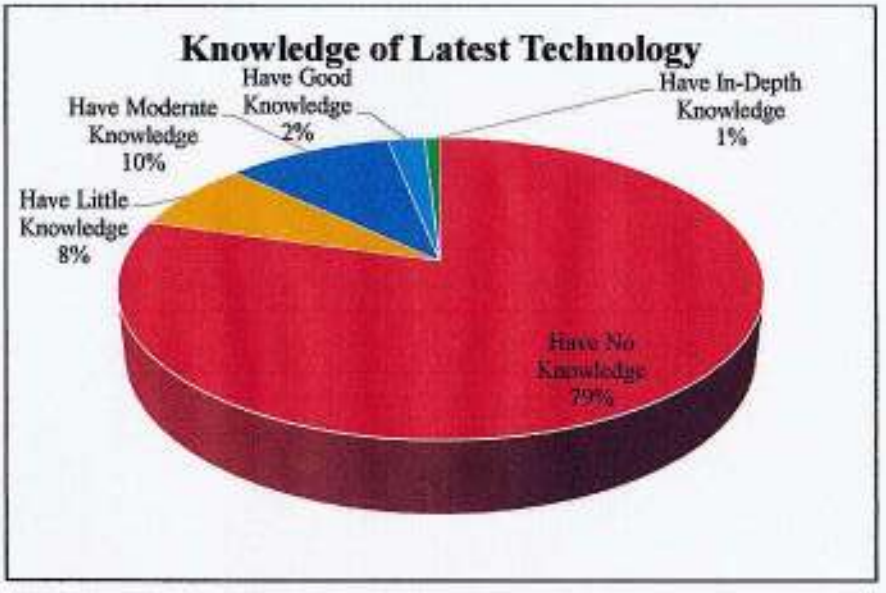

Figure 5.22: Knowledge of latest technologies.

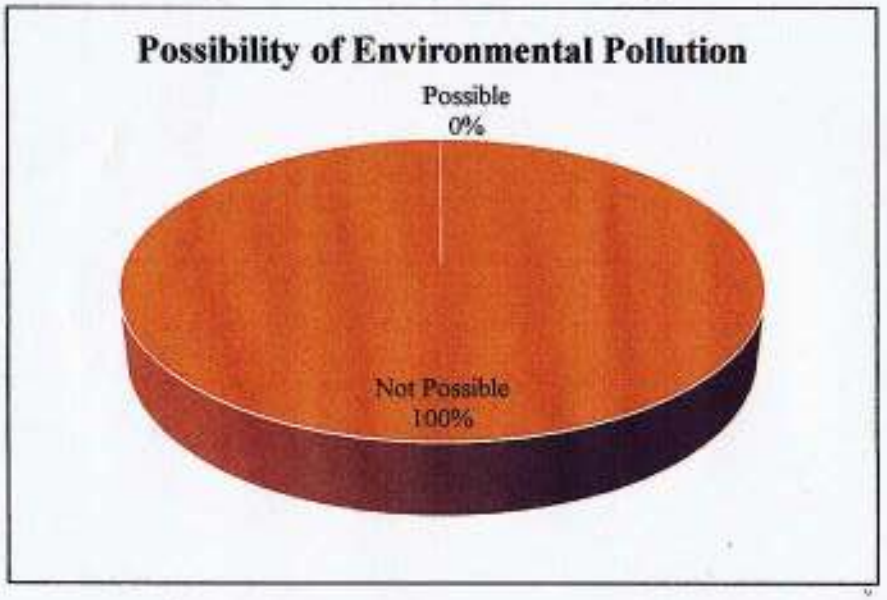

Figure 5.23: Mindset towards environmental pollution.

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Figure 5.24 shows that most of the workers are not willing to use any personal protection equipment (PPE). Therefore, it may be concluded that the mindset of the workers has to be changed through counseling and training.

Finally, Figure 5.25 shows the expectation of the industry owners from the government. From Figure 5.25, it may be observed that the industry owners have suggested multiple approaches for the betterment of the cluster. Among those, availability of new technology, training facility and education, regulations on import of products that are manufactured locally and financial help have been given special priority.

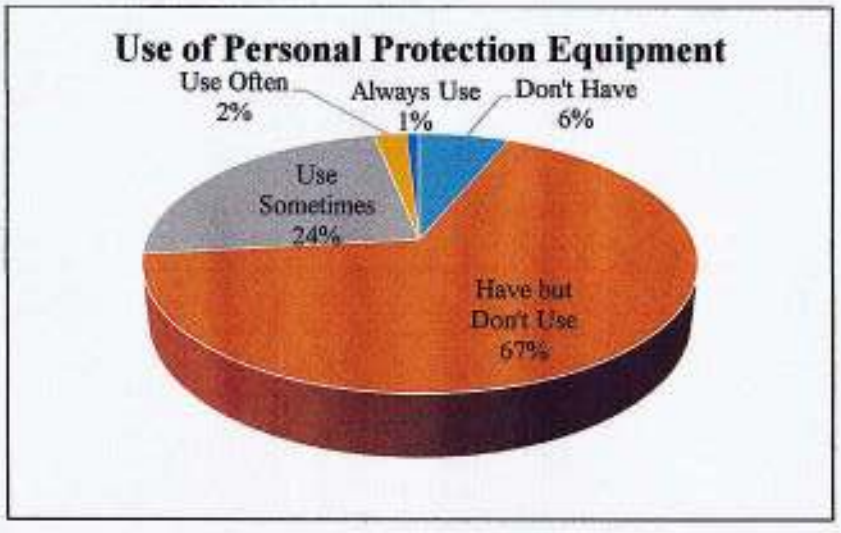

Figure 5.24: Mindset towards using PPE.

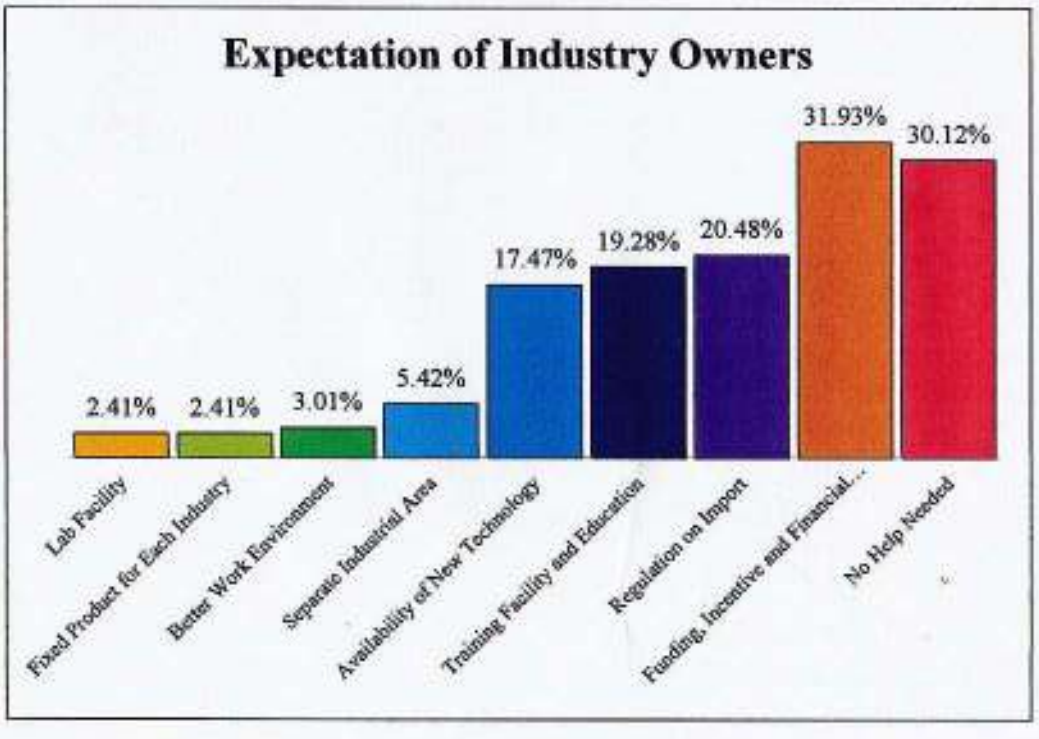

Figure 5.25: Expectation of the Industry Owners of the Cluster.

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5.2 Technical Workforce in the Cluster

It may be observed that there are currently no BSc. Engineers or Diploma Engineers working in this cluster. It is noteworthy that a few years back, two foundries had BSc. engineers working for them. However, they don't have any engineer right now. This indicates that they lack the skilled manpower to develop the quality of the products and production process. They are in need of Mechanical or Industrial and Production Engineers for efficient production and machine operation as well as Chemical or Materials and Metallurgical Engineers for ensuring better composition of the metallic products. It is noteworthy that there is a university and multiple technical institutions in this region that are producing BSc. And Diploma Engineers in related fields. The number of students passing from these institutions is presented in Table 5.1. It is noteworthy that there is no university or institution in this region that offers BSc. In Material and Metallurgical Engineering which is a major drawback for this cluster.

Table 5.1: List of universities/institutions with number of students passing each year

University/ Institution	Degree offered	Students passing each year
Jashore University of Science and Technology, Jashore (JUST)	BSc. in Industrial and Production Engineering	35
	BSc. in Chemical Engineering	40
BCMC College of Engineering and Technology, Jashore	BSc. in Industrial and Production Engineering	50
	BSc. in Mechanical Engineering	50
	Diploma in Mechanical Engineering	48
Jashore Polytechnic Institute	Diploma in Mechanical Engineering	150

5.3 Findings from FGDs

The research team has conducted three separate Focus Group Discussions (FGDs); one with the foundry owners, one with the workshop owners and one with workers. The three FGDs have unfolded different findings regarding the sector and some expectations of the stakeholders from both JUST and SME foundation. The key findings are summarized in the Table 5.2 below:

Table 5.2: Key findings from FGDs

	Participants	Number of Participants	Date and Time	Key Findings and Suggestions
FGD-1	Foundry Owners	12	01/01/2020 08:00pm-10:00pm	1. There is no efficient and accurate pattern making facility. CNC-based pattern making is required. Help from JUST is expected in this matter. 2. Quality testing facilities are not adequate. The tests are still being conducted in Dhaka. Help from JUST

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				is expected. Research laboratories should also be established. 3. The foundry owners don't know how they may improve the quality of their product. Need proper guidance in this regard. 4. Training of workers is required for new machineries such as CNC lathe, CNC milling machine, etc. 5. Rate of interest of loan should be decreased for a certain period of time so that owners may avail new technology or expand their business.
FGD-2	Workers	16	23/02/2020 04:00pm- 5:30pm	1. The working environment and salary range in this sector is discouraging for the workers. As a result, people are not willing to get in this sector. 2. The Chinese machines are better in quality than the Indian machines. However, Indian machines are cheaper and are preferred by the owners. This compromises the quality of products. Nonetheless, both Chinese and Indian machines are far superior to locally manufactured machines. 3. Some of the old, experienced workers are capable of becoming trainers. However, they don't have any formal recognition. Certification of their skill is required.
FGD-3	Workshop Owners	11	23/02/2020 07:30pm- 09:00pm	1. The industries are not located in a fixed area. As a result, it is difficult to get transportation and other facilities. 2. There is scarcity of skilled worker, as people are not interested in working in this type of environment. Also, other jobs with better salary are available. Finally, it is necessary to let children above 14 years work in this sector to develop manpower. 3. Quality testing laboratories are required. 4. Heat treatment facilities are not available in this region. As a result, many machineries and products can't be produced. This facility should be ensured. 5. Most of the machines used here are old and backdated. New machines are required for better product quality. 6. Technology Fair should be arranged on regular basis. 7. Funding and loan facilities should be increased so that new technology can be availed. 8. Finally, demand of many agricultural machineries has reduced due to poor economic condition of the farmers. This is affecting the light engineering sector indirectly. For development of

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				this sector, development of farmers is also necessary.

5.4 Findings from KIIs

The research team of JUST has conducted six Key Informant Interviews (KIIs) in order to validate the survey results and the findings from FGDs. The findings from these KIIs are given below:

Table 5.3: Findings from the KIIs

	Participant Name, Designation and Organization	Information Shared
KII-1	Mr. Biswajit Barai Foreign Consultant (India), Works for Ripon Metal and Foundry, Jashore	1. The workers here are not willing to change and learn new things. They like to work in conventional way. As a result, they are less adaptive to changing situation. However, the workers are very skilled in what they do. 2. Most of the owners are not interested in establishing laboratory facilities in their industries due to investment issues and lack of knowledge. Still, some industries have established laboratories in limited scale.
KII-2	Mr. Akbar Ali Pattern Maker, Akbar Pattern, BISCIC Industrial Area, Jashore	1. There are only two wooden pattern makers in this region. This number is not sufficient. 2. It is not possible to develop another person as pattern maker easily since it takes years of practice and people in young age are most suited for learning this.
KII-3	Md. Forkan Hossain Raw Material Supplier, Bismillah Metal, Jashore	1. The raw metal iron is mostly supplied from ship-breaking. These ship-breaking steels are very high quality steels. Therefore, they can easily be used in any type of furnace without worrying about the quality of the casting. This is the exact reason why most foundries are relying on ship-breaking. 2. The cost per KG of ship-breaking iron is very close to the cost per KG of iron from ore in India. As a result, the cost of raw materials in foundry are almost the same for both countries. The only reason the Indian machines are cheap is mass production. 3. There is no alternate and sustainable source of raw material in this country other than from ship-breaking, which is alarming.
KII-4	Md. Mahbub Alam Chemical Supplier, Mahabub Foundry, Dhaka	1. Some foundry owners have chemists and they can identify the required chemical for their works accurately. 2. Most of the foundry owners depend on the chemical supplier in case of right chemical selection for their works.
KII-5	Mr. Debasish Paul Branch Manager,	1. The number of loan applications are low in this branch.

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	One Bank Limited, Jashore Branch	2. Most owners of foundry and engineering workshops can't show enough property or asset to get desired amount of loan.
KII-6	Mr. Sk. Syid Ahmed Branch Manager, IDLC Finance Limited, Jashore Branch	1. The interest rate for loan in SME sector is lower (9%) than other sectors (13-15%). However, the allocated amount for SME lone is limited. If the amount allocated has already been distributed for a year, the remaining SMEs will have to avail loan in regular interest rate. 2. Most of the owners ask for working capital loan. Since the amount can't be higher than the asset of the owner, the amount given as a loan is limited (2-5 lacs). 3. Most owners can't arrange granter, which is why they don't get loan.
KII-7	Md. Lavlu Pattern Maker, Lavlu Pattern, BISCIC Industrial Area, Jashore	1. Pattern making time is very high due to not having the advanced machines. 2. New pattern makers are not developing because of low financial return. 3. Advanced machineries cannot be adopted because of high investment and lack of knowledge.

5.5 Suggested Actions in the Validation Workshop

A validation workshop was conducted with the experts and stakeholder of this sector on 29th June, 2020 to discuss the results of this study. The experts and stakeholder provided some opinion regarding the results of the study and gave suggestions for future action plan. A summary of the validation workshop is presented in Table 5.4.

Table 5.4: Findings from the Validation Workshop

Participant Name, Designation and Organization	Opinion/ Suggestion
Mr. Ashrafuzzaman Babu President, Bangladesh Engineering Industries Owners Association (BEIOA), Jashore	1. The major limitations of this cluster are lack of investment and modern technology. Large-scale investment is required to introduce modern technologies in this cluster. 2. Loan facilities on easy terms are to be increased and tax on raw material import is to be decreased.
Dr. Md. Abdul Gafur Principal Scientific Officer, Bangladesh Council of Industrial and Scientific Research, Dhaka	1. ESQ compliance may be assured. 2. AAS is a complicated technology. HHXRF should be more convenient for the owners. 3. Sand testing and sand processing set up is to be introduced in the cluster. 4. Mold design and casting design should be given special importance. 5. Raw material is currently not one of the strengths for our country. New materials such as high-carbon steels, high-chromium steels, etc. may be developed to overcome this situation. 6. Reverse engineering is an option to manufacture quality products. 7. Pricing is a big problem for the industries in this

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	cluster. Good pricing strategy is to be developed for the owners. 8. Metallography is an essential part for the development of the foundry industries. Thus, special emphasis has to be given on materials and metallurgical engineering sector. 9. Local collaboration is possible only when the local institutions have required lab facilities and manpower. This has to be ensured. 10. Worker pricing is not impressive in this sector. This is one of the reasons why workforce has become so scarce. 11. Finally, Government and SMEF have to take the lead in providing necessary trainings and other supports for the development of this cluster.
Dr. Md. Jalal Uddin Director, Chattogram (attached to Dhaka) & Project Director, Women's Hostel Project, Bangladesh Industrial Training Assistance Center, Dhaka	1. A comparative study on material composition, microstructure and mechanical properties may be conducted between the products manufactured in Jashore Cluster and high quality imported products to motivate the industry owners about quality testing. 2. Market analysis for selecting products to be manufactured may be conducted.
Dr. Fahmida Gulshan Professor and Head, Department of Materials and Metallurgical Engineering, BUET, Dhaka	1. More materials and metallurgical engineers are to be involved for the development of this cluster. 2. Proposal may be submitted to the Government for issuing loan to the industry owners who are willing to develop products that are imported from other countries. 3. A similar study may be conducted to reflect the overall scenario of Bangladesh
Dr. Abdullahil Azeem Professor, Department of Industrial and Production Engineering, BUET, Dhaka	1. The study may be extended with materials and metallurgical engineering experts to add some more information to the findings of this study. 2. Only research is not enough, implementation is more important.
Dr. Parvez Sazzad Chowdhury Ministry of Education, Bangladesh	1. The study may be extended to accommodate the opinion of stakeholder i.e. the consumers of the products. 2. More similar research should be conducted. 3. One-stop service may be established in all the cluster areas for providing better service to the industry owners. 4. Collaboration between SMEF and BITAC may be established. 5. Certification of the skilled workers may be arranged by SMEF.
Mr. Habibur Rahman Consultant	1. SMEF has to focus on translating the results of this report to develop a proper action plan for future. 2. Affordability analysis is also required. 3. The supply side of the human resources has to be focused on to ensure continuous supply of workers. 4. A knowledge platform may be established for the development of the cluster. 5. Policy dimension may be emphasized on. For this, an action group may be formed with experts in this field.
Dr. Md. Mafizur Rahman Director General, Bangladesh Industrial Training Assistance Center, Dhaka	1. Interest-free loan is not feasible. Loan on easy terms and conditions is a more practical option. 2. In order to compete with Indian and Chinese products, it is necessary to improve quality of local products. It is necessary to make the industry owners understand this truth so that they realize the importance of quality improvement.

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	3. BITAC and other similar institutions should bring the testing facilities in every corner of Bangladesh. 4. Market study on Light Engineering products is necessary.
Mr. Abdur Razzaque President, Bangladesh Engineering Industries Owners Association (BEIOA), Dhaka	1. Only bringing new technology is not enough, skilled manpower to use these technologies is also necessary. 2. Industrial Park is necessary for this sector to flourish. 3. India has developed in LE sector due to the funding provided by the Government. Therefore, this is needed in our country too. 4. A common facility center should be established in this cluster. 5. Action plan is needed for further progression.

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CHAPTER 6

MAJOR CHALLENGES AND SUGGESTIONS

6.1 Challenges

Identifying the potential areas of improvement doesn't necessarily ensure that improvement is achievable right away. There are certain obstacles that are to be overcome in order to achieve the development goal. While collecting data from the stakeholders and other key informants, some major challenges towards development of the Jashore Light Engineering (LE) cluster have been identified. These challenges are listed below:

- The first and foremost challenge towards development is the lack of adequate knowledge of the stakeholders about some of the resent technological improvements in this sector. Most of the owners of these industries are not aware of the advantages of employing latest technologies such as lower power consumption, greater productivity, reduced manpower requirement, etc. They also lack the knowledge required to forecast future changes in this sector, thus they don't realize the need to update and upgrade. Therefore, most of them are not yet interested in employing machineries with latest technological upgrades and are still reliant on conventional and old machineries. This is why most of them are not willing to invest their money on new machines; instead they tend to buy old ones. Changing the views of the vast majority of the stakeholders is one of the biggest challenges.
- Another major challenge is the availability of skilled manpower to run new, improved machineries. Most of the light engineering industries of this cluster have not-so-educated workers and supervisors who are very skilled in operating old and manual machines. It would be very difficult to train them for operating automatic or semi-automatic machines without a certain level of education. Again, it is not possible for the owners of these industries to appoint highly or moderately educated people as they won't be able to give them a good salary in their current financial situation.
- In many industries, it is very difficult to get long-term workers due to the workplace environment of these industries. The nature of many light engineering industries doesn't make the workplace environment of those industries attractive to the workers. As a result, they are not getting sufficient new workers whom they can train and appoint to work.

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- ❖ Not all the industries will be able to bring in new technologies due to financial issues. Majority of them lack the ability to bear the load of the initial investment, especially the small workshops.
- ❖ Finally, it is very difficult to change the mindset of the workers and supervisors and train them. In many cases, they are not willing to change themselves with time. Many are not willing to adapt to new techniques or technologies and like to work in old-fashioned way. This may greatly delay the overall development of this sector.

6.2 Suggestions

In order to overcome these challenges, the following suggestions are given:

- ➢ Frequent trainings, workshops and awareness programs are necessary to familiarize both the stakeholders and the workers with the latest technological developments in this sector and their benefits. The training modules should include:
    - Training on Optimum mold design and casting design.
    - Training on semi-automatic, automatic and CNC machine tools.
    - Training on International Standards and proper use of measurement devices.
    - Workshop on proper use of PPEs.
    - Awareness program on importance and benefits of quality assurance.
    - Awareness program on environmental pollution and effects.
- ➢ Multiple research laboratories may be established in this cluster which will serve the purpose of all the light engineering industries situated within a fixed area around each laboratory. Also, it is very important to identify which type of laboratory is required in a specific area depending on the characteristics of the industries around it. Some of the suggested laboratory facilities include:
    - ❖ Material composition testing laboratory (For example, Optical Emission Spectrometry (OES), Atomic Absorption Spectrometry (AAS), Handheld X-ray Fluorescent Spectrometry (HHXRF), etc.)
    - ❖ Mechanical properties testing laboratory (For example, Hardness Testing Machine, Universal testing Machine etc.)
    - ❖ Heat Treatment Laboratory
    - ❖ Sand Testing and Sand Processing Laboratory (For example, Temperature Measurement Device, Humidity Measurement Device, etc.)
- ➢ Funding programs may be initiated for the aid of the owners.

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- A dedicated CNC and 3D Printer-based Pattern-making facility may be established.
- Knowledge must be shared on quality conformation i.e. dimensions and properties of different products to meet international standards.
- It is necessary to focus on changing the typical mindset of the workers and supervisors so that they don't feel any hesitation while adapting to new techniques and technologies.
- The training modules for the workers should be designed in such a manner that people with comparatively less educational background may learn performing basic operations in automatic and semi-automatic machines.
- Finally, focusing on how to make the workplace environment of these industries better is a must. To ensure ESQ compliance, the following sectors may be focused on:
    - Fire safety,
    - Occupational health and safety,
    - Gender sensitivity,
    - Health safety mechanisms and checkup, etc.

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CHAPTER 7
SWOT ANALYSIS

The SWOT analysis of Jashore Light Engineering Cluster is based upon the information from the survey and focused group discussion and the followings have been observed:

7.1 Strength

Technology:

- In case of foundry, almost latest technology (induction furnace) is used by some industries in the cluster and the others are trying to adopt this latest technology.
- In case of machining, almost all the traditional machines (lathe, milling, shaper, drilling machine etc.) are available for the owners in the cluster.
- Installation of latest technology (induction furnace) for foundry industries does not require high investment.

Skills:

- In machining industries, there exists some highly experienced and skilled workers who can even make some sophisticated machining works.
- In machining industries, existing workers are expert and skilled enough in case of traditional machines.
- Some workers are expert enough to train other workers.
- Most of the skills are acquired on job.

Inputs:

- Raw materials such as iron are available in sufficient quantity to produce Mild Steel and Cast Iron.
- Other required materials such as sand, different chemicals etc. are easily available.
- In machining industries, machine experts are available to resolve any problem for traditional machines.

Market:

- Demand exists from agro industry, stone crushing farm, textiles, automobiles, bakery industries.

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- Some products such as stone crusher machine, bakery machineries, break drum etc. have enormous potential for exporting from the cluster.
- Good scope exists for marketing the products through trade fairs.
- Some products such as cooking pan, stone crusher machine, automobile accessories etc. have the advantage of being famous by proper branding.

Business Environment:

- Bangladesh Engineering Industry Owners' Association (BEIOA) is very focused on the development of the cluster by arranging different training programs, fairs and workshops.
- Bangladesh government is trying to boost the sector by taking different initiatives (Prime Minister has declared the year 2020 as the Light Engineering Product year).

7.2 Weakness

Technology:

- In case of foundry industries, there exists insufficient number (only two) of expert pattern makers in the cluster. As a result, foundry industries are not getting their required patterns timely.
- There exists lack of information about the new and latest machines and technology among the owners, foreman and workers.
- Casting design, mold design, reverse engineering, etc. are completely absent in this cluster.
- Some foundry industries have tried to adopt pressure die casting but have failed due to lack of knowledge and technical support.
- Sand testing and sand purification setup is absent in the foundries.
- There exists lack of quality testing lab/facilities in the cluster for both foundry and machining industries.
- In case of machining industries, the owners and workers face the cutting tool related problem (size, shape related issues).
- Machining industries also have no separate heat treatment facilities. They rely on the blacksmith.

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- The machining industries use the traditional method of production. They do not have the latest machining technologies like CNC machine. Most of the industries do not have the latest technology for measurement.
- Productivity level of the foundry and machining industries is very low.
- Most of the industries do not have proper layout.

Skills:

- There exists lack of knowledge about different materials composition, sand type, molds etc. among the owners, foreman and workers.
- The owners and workers do not have proper knowledge about the heat treatment of the products.
- There exists over dependence on traditional skill in the cluster.
- There are inadequate skill development and hands-on training facilities on latest technologies in the cluster.

Inputs:

- Raw materials for high grade steel production are scarce in this cluster, making it difficult to manufacture some automobile spare parts.
- There exists scarcity of skilled and semi-skilled workers in the cluster.
- The most alarming matter is that the workers are losing interest in this sector. They tend to switch their jobs to other available works because of low salary and long working hour.
- In case of foundry industries, there lacks local experts on induction furnace in the cluster.
- The cluster lacks expert chemist for testing different materials compositions.
- Sometimes it becomes difficult to get right quality raw materials.

Market:

- Automobile parts are not cost competitive compared with China products.
- Downward situation in agriculture causes poor market conditions for agricultural machines and machine parts.
- Very few branding and marketing activities are undertaken.
- There is no pricing strategy.

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Business Environment:

- Import of different parts from other countries which are locally produced.
- High rate of VAT on manufactured items.
- Competition is very high.

Innovation Capabilities:

- Very few foundry and machining industries are trying to incorporate innovation in design and production process of their products.
- No change in technology and machine application over long time.
- There is no innovative marketing strategy.
- The industries have no innovative pricing strategy.

7.3 Opportunity

Technology:

- New and modern technologies can be tested in local university and institution before adopting in the industries.
- Common quality and materials property testing facilities can be established in the cluster.
- Productivity and efficiency can be improved through implementing different modern management philosophy such as 5S, kaizen, total productive maintenance (TPM) etc.
- Data bank for international materials composition standard can be purchased.
- Pressure die casting can be introduced in the cluster.
- A platform (such as website) for information about modern machines and technologies can be developed.
- A common CNC machine facilities can be established for rapid prototyping and pattern making.

Skills:

- The training program on existing and modern machining process, welding, molding and heat treatment process can be arranged for skill up-gradation of workers.
- Special training on CNC machine can be arranged for workers to resolve the pattern making issues.

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- Collaboration between industries and vocational institutes can be increased in the cluster.
- Internal trainers can be developed through conducting TOT (training of trainers) program which will be cost-effective.
- Training on entrepreneurship can be arranged in the cluster.
- Management training program can be arranged for manager, foreman and supervisor.

Inputs:

- The foundry and machining industries in the cluster can attract more work force by improving the work environment, introduction of different incentive program and insurance.
- There is a scope of developing local business development service (BDS) for the foundry and machining industries in the cluster.
- Scope exists for increasing supplier relationships with the industries.

Market:

- Brand building can help the industries to compete in the market.
- Marketing consultants can help the industries in the cluster to adopt effective marketing strategy.
- Some foundry and machining industries can go for direct export.
- A platform can be established for information about the global market (Specially China and India).
- Enterprises can participate local and international fairs for understanding the local and international market.

Business environment:

- Association can arrange regular knowledge sharing program.
- Government can develop special technology cell for technical support in the cluster.

Innovation capabilities:

- Changes in the layout can improve the productivity of foundry and machining industries.

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- Some enterprises have the capability of innovative product development. However, they require training on product development, design development, branding, promotion and packaging.

7.4 Threat

Technology:

- Educational level of the workers may restrict the adaptation of new technology.
- Financial constraints may restrict the modernization.

Skills:

- Lack of development of new skilled workers is the biggest threat for this cluster.
- Unless newer skill development takes place, quality and productivity will decrease. Then it will become difficult for the foundry and machining industries to survive in the market.

Inputs:

- Lack of workforce is the biggest threat.
- Raw material price may increase.
- Enterprises will be fully dependent on foreign BDS providers due to lack of local BDS development.

Market:

- Competition in the market is going to increase.
- Cheaper and innovative alternative materials, products and production processes are posing tough competition.
- Without branding and marketing it will become difficult to survive in the market.

Business environment:

- Economic condition of the country can pose uncertainty.

Innovation:

- Competitors (Specially China and India) may adapt more innovations.

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7.5 Strategic Direction of the Action Plan

Jashore Light Engineering Cluster has good growth potential provided strategic interventions are made in certain key areas.

The key areas that require strategic interventions are listed as follows:

- Manufacturing technology up-gradation
- Networking
- Business development service (BDS) provider development
- Product/Market diversification
- Price controlling strategy

The strategic interventions of action plans are explained in the following. However, it should be noted that the action plans are not of imposed nature. The cluster actors should realize the need to take initiatives to bring about the change.

7.5.1 Manufacturing Technology Up-gradation

- Introduction of induction furnace in all foundry industries.
- Introduction of pressure die casting technology.
- Common CNC machine for pattern making and rapid prototyping.
- Modern measuring tools should be introduced.
- Semi-automatic lathe and milling machines should be introduced initially.
- Common metallurgical and quality testing lab should be established.
- Heat treatment facilities require up-gradation.
- Reverse engineering is to be introduced.

7.5.2 Networking

Networking among the enterprises in the cluster is not satisfactory. Although, there is an association, there exists information gap among the cluster actors. The association needs to strengthen the network with other national and international organizations, NGOs for the development of the cluster. The joint actions of the enterprises in the cluster should be increased.

7.5.3 Business Development Service (BDS) Provider Development

Currently there are no local business development service (BDS) providers in the cluster. BDS in the area of furnace technology, materials composition, casting technology, modern

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machining, product design and development, branding, marketing, and export promotion need to be developed in the cluster.

7.5.4 Product/Market Diversification

As it appears that major technological changes are not required for foundry industries. However, quality up-gradation of the casting parts is required. On the other hand, some major technological changes are required for machining industries. Stone crushing machine, different bakery machine, agricultural machines etc. are popular in many areas in Bangladesh. Stone crushing machine is very popular in some parts in India. But, hardly any initiative has been taken to market the products to distance place in the country and abroad. Based on this analysis the following activities may be organized at the cluster:

- Training and workshops on branding, export procedure and documentation
- Participating the international trade fair and exhibitions
- Workshops on marketing strategy
- Product design and development training
- Organizing meetings with the cluster actors
- Training program on entrepreneurship development
- Personal counselling in solving problems
- Quality standardization
- Workshops on health and safety measures
- Workshop on different modern technology
- Training and workshop on different modern management philosophies
- Development of common platform (Such as website) for information sharing

Along with these activities, it is necessary to introduce production of new materials such as medium-carbon and high-carbon steels, stainless steels, etc. so that new products may be developed in this cluster. Also, it is necessary to identify which products are being imported from China and India. After identifying the products, initiatives may be taken to manufacture those products in the cluster to achieve diversification.

CHAPTER 8
CONCLUSION

Jahore Light Engineering Cluster has a huge potential, if monitored properly. The process of new technology adaptation is still slow in this cluster. The workforces are skilled enough in operating old and traditional technologies. But, they have little knowledge on modern technologies, testing and heat treatment and productivity improvement. Moreover, no significant initiatives have been taken by the actors for new market creation and product development. This study has put forth a vision on technology and skill gap analysis of this cluster and proposed some development areas to convert that vision to reality. Some principle recurring themes developed:

- Establishment of common facilities at the cluster for quality and material testing, and advanced technologies.
- Arrangement of training programs for workers on welding, testing and heat treatment, materials composition, and advanced technologies. These trainings may be funded by Government of Bangladesh or any other dedicated organization such as SMEF. Also, the trainings are to be organized keeping in mind the convenience of the stakeholders.
- Collaboration should be established with local research institutions and universities for training the workers on modern technologies.
- More Industrial engineers and Material and Metallurgical Engineers are to be involved in the development of this cluster since they have expertise in foundry technology, machine tools, productivity improvement, layout design, material development, heat treatment, etc.
- Development of internal trainers through arranging training for trainers (TOT).
- Development of new product and creation of new markets in home and abroad.
- Development of work place for attracting new workers through building awareness on labor-law, safety and environment compliance among the owners.
- Training on efficient costing and pricing strategy.
- Training of foreman and supervisor on modern management philosophy and quality management system.
- Formulation of strategic branding and marketing strategies in the cluster immediately.

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The growth of the Light Engineering Sector in Jashore as well as in Bangladesh will be increased if the skill and technology gaps identified in this study are minimized. Introduction of advanced technology will improve the flexibility, capacity and productivity of foundry and machining industries. The vision that has been presented in this report is more than feasible. Some interventions already exist in some industries and some are being practiced in many industries around the world.

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ANNEXURES

Annex 01- Survey Instrument (For owners)

Title: Survey Questionnaire on Skill & Technology Gap Assessment of Light Engineering SMEs of Jashore Cluster (For owners)

1. Name of interviewee:

2. Organization name and address:

3. Nature of ownership:

4. No. of employees:

5. Product and production information:

5.1. Major finished products :

5.2. Target customers (Industry served) : (a) Textile (b) Automobile (c) Others.....

5.3. Monthly production (Amount & BDT) :

5.4. Average monthly income (BDT) :

6. Raw materials information:

Types of raw materials used	Sources	Monthly demand	Monthly Supply

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7. Technological information:

Name of technology/machine	Quantity	Type (Automatic/semi-automatic/manual)	Source (Local/Imported)	Current condition

8. Current production process flow chart:

9. Do you think that there are gaps in the manufacturing technologies that you are using presently?

Yes/No.

If yes please list the technology gaps and name the process where it occurs.

10. How these technological gaps can be resolved? Please give your opinion.

11. Do you take any consultancy service from any individual or any organization?

Yes/No

If yes please list the services they provide.

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12. Employee related information:

Supervisor	Permanent		Temporary	
	Male	Female	Male	Female

13. Skill related information:

Trade name	No. of workers	Cannot perform	Can perform with help	Can perform solo	Can perform with high proficiency	Can perform and train others

14. Are skilled and well-trained workers/technicians easily available?

Yes/No.

If not, then what do you do to train the workers/technicians?

What type of training modules do you think are required to produce a good quality well trained workers/technicians?

15. What are the basic skills/qualification of workers/technicians that you require?

	Workers/Technicians	Supervisor	Engineer
Skills & Qualification			
Currently required number			

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16. Quality related information (From raw materials to final product)

Name of quality check/testing	How do you perform?	From where?	Is it adequate? If not then mention the reasons

17. Are you aware of advanced technology in your field of operations? If yes. Please tell the source of information and what are those advanced technologies?

18. What are the environmental problems associated with your production process?

19. How do you ensure that your employees are using personal protective equipment during work?

20. What do you expect from the government for technological assistance?

21. Any other suggestion you want to share to improve your industry/cluster:

Interviewer name:

Signature of the Interviewee & Date

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জরিপ ফর্ম -১ (মালিকদের জন্য)

শিরোনামঃ যশোর লাইট ইঞ্জিনিয়ারিং এস এম ই এর ক্ষেত্রে কর্মদক্ষতা এবং ব্যবহারিত প্রযুক্তির বর্তমান অবস্থা নিরূপণের জন্য প্রশ্নাবলী (মালিকদের জন্য)

১।সাক্ষাতকার প্রদানকারীর নামঃ
২। প্রতিষ্ঠানের নাম ও ঠিকানাঃ
৩। মালিকানার ধরনঃ
৪। কর্মী সংখ্যাঃ
৫। পণ্য ও পণ্যের উৎপাদন সংক্রান্ত তথ্যঃ
৫(১) প্রধান উৎপাদিত পন্যসমূহঃ

৫(২) প্রধান ক্রেতা ও সেবাগ্রহীতাঃ (ক) টেক্সটাইল (খ) অটোমোবাইল (গ) অন্যান্য.....

৫(৩) মাসিক উৎপাদন (পরিমাণ ও টাকা) :
৫(৪) গড় মাসিক বিক্রয় (টাকা)
৬। কাঁচামাল সংক্রান্ত তথ্যঃ

কাঁচামালের নাম ও ধরন	উৎস	মাসিক চাহিদা	মাসিক যোগান

৭। প্রযুক্তি সংক্রান্ত তথ্যঃ

প্রযুক্তি/মেশিনের নাম	সংখ্যা	ধরন (অটোমেটিক/ সেমি-অটোমেটিক/ ম্যানুয়াল)	উৎস (লোকাল/ ইম্পোর্টেড-দেশ)	বর্তমান অবস্থা

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৮। বর্তমান উৎপাদন প্রক্রিয়ার প্রবাহ চিত্রঃ

৯। আপনি কি মনে করেন যে বর্তমানে যে ধরনের প্রযুক্তি আপনি ব্যবহার করছেন তাতে কোন সমস্যা আছে?
হ্যাঁ/না
যদি হ্যাঁ হয়, তাহলে বর্তমান প্রযুক্তি ও উৎপাদন প্রক্রিয়ায় কি কি সমস্যা আছে সেগুলো উল্লেখ করুনঃ

১০। এই সকল প্রযুক্তি ও উৎপাদন প্রক্রিয়াগত সমস্যাগুলো কিভাবে সমাধান করা যেতে পারে বলে আপনি মনে করেনঃ

১১। আপনি কি কোন ব্যক্তি বা প্রতিষ্ঠান থেকে কোন ধরনের কন্সাল্টেন্সি/পরামর্শ সেবা গ্রহণ করে থাকেন বা কখনো গ্রহণ করেছেন?
হ্যাঁ/না
যদি হ্যাঁ হয়, তাহলে কি কি সেবা গ্রহণ করে থাকেন সেগুলো উল্লেখ করুনঃ

১২। কর্মী সংক্রান্ত তথ্যঃ

সুপারভাইজার	স্থায়ী টেকনিশিয়ান/কর্মী		অস্থায়ী টেকনিশিয়ান/কর্মী	
	পুরুষ	মহিলা	পুরুষ	মহিলা

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১৩। দক্ষতা সংক্রান্ত তথ্যঃ

ট্রেডের নাম	কর্মী সংখ্যা	একেবারেই কাজ পারেনা	কাজ পারে কিন্তু সাহায্যের প্রয়োজন হয়	একা একাই কাজ করতে পারে	খুবই ভালভাবে কাজ করতে পারে	নিজে পারে এবং অন্যকে ট্রেনিং দিতে পারে

১৪। দক্ষ এবং ভাল প্রশিক্ষনপ্রাপ্ত কর্মী/টেকনিশিয়ান কি সহজলভ্য?
হ্যাঁ/না
যদি না হয়, তাহলে তাদের ট্রেনিং দেওয়ার জন্য আপনারা কি কি করেন?

গুনগত মানসম্পন্ন ও দক্ষতা সম্পন্ন কর্মী এবং টেকনিশিয়ান তৈরী করতে কি কি ট্রেনিং মডউল প্রয়োজন আছে বলে আপনি মনে করেন?

১৫। কি কি দক্ষতা/গুণসম্পন্ন কর্মী বা টেকনিশিয়ান আপনার প্রয়োজন?

	কর্মী/টেকনিশিয়ান	সুপারভাইজার	ইঞ্জিনিয়ার
প্রয়োজনীয় দক্ষতাসমূহ			
প্রয়োজনীয় কর্মীসংখ্যা			

১৬। গুণগত মান সংক্রান্ত তথ্য (কাঁচামাল থেকে উৎপাদিত পণ্য পর্যন্ত)

মান নির্ণয়/ টেষ্টের নাম	কিভাবে করে থাকেন?	কোন জায়গা থেকে করেন?	এটা কি পর্যাপ্ত? যদি না হয় তাহলে তার কারণ

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১৭। আপনার ক্ষেত্রের আধুনিক ও সর্বশেষ প্রযুক্তি/মেশিন সম্পর্কে কি আপনি অবগত? যদি হ্যাঁ হয়, তাহলে সেইসব প্রযুক্তি/মেশিন এর নাম এবং কোন উৎস থেকে আপনি তথ্য পেয়েছেন তার নাম উল্লেখ করুনঃ

১৮। আপনার পণ্য উৎপাদনের সময় পরিবেশের উপর কি কি প্রভাব পড়ে বলে আপনি মনে করেন?

১৯। কাজের সময় আপনার কর্মীরা ব্যক্তিগত নিরাপত্তার ইকুইপমেন্ট ব্যবহার করছে কিনা এটা আপনি কিভাবে নিশ্চিত করেন?

২০। প্রযুক্তি সংক্রান্ত সমস্যা সমাধানের ক্ষেত্রে সরকারের কাছ থেকে আপনি কি ধরনের সহযোগীতা কামনা করেন?

২১। এই শিল্পক্ষেত্র/ক্লাষ্টারের উন্নতির জন্য আপনার পরামর্শ সমূহঃ

সাক্ষাতকার গ্রহণকারীর নামঃ
তারিখঃ

সাক্ষাতকার প্রদানকারীর স্বাক্ষর ও

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Annex 02-Survey Questionnaire for Supervisors

Title: Survey Questionnaire on Skill & Technology Gap Assessment of Light Engineering SMEs of Jashore Cluster (For supervisors)

Dear respondent, this study is related to the light engineering small and medium enterprises (SMEs) of Jashore cluster. The objectives of this study are to get a comprehensive overview of this sector including present condition of this sector and assess the skill and technology gap. We thank you for your kind participation. Your valuable comments and observations will help us to recommend effective strategies for overcoming the skill and technology gap and boosting the growth of this sector further. Your response will be used only for research purpose.

1. Name of the interviewee:

2. Organization name:

3. Address:

4. Interviewee information:

4.1. Gender: (a) Male (b) Female

4.2. Age: (a) Below 20 (b) 20 to 30 (c) 30 to 40 (d) 40 to 50 (e) Above 50

4.3. Education level: (a) Primary (b) Secondary (c) HSC (d) Graduate (e) Post graduate

5. Product and production information:

5.1. Major finished products :

5.2. Quality level of products : (a) Very low (b) Low (c) Medium (c) High (d) Very high

5.3. Target customers (Industry served) : (a) Textile (b) Automobile (c) Others.....

6. Technological information:

6.1. Technologies/ Equipment used:

Name of technology	Quantity	Type (Automatic/semi-automatic/manual)	Source (Local/Imported)	Current condition	Maintenance type with frequency

6.2. List the tools used in your industry/ workshop:

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6.3. Do you know about some of the latest technologies related to your work? (Yes/ No) If yes, which ones?

6.3. What are the major technical and technological challenges do you face?

7. Current production process flow chart:

8. Skill related information:

8.1. Skill level of specific job:

Job description	Skill Level					
	0 (Can't do)	1 (Very low)	2 (Low)	3 (Moderate)	4 (High)	5 (Very High)

Mojahid

Abidhossain

8.2. Training and development:

Name of job	Training provided internally	Training provided externally	Name of training center

8.3 Worker Details:

Category	Gender	Education	Training
Diploma Engineer	Male:		
	Female:		
Technician	Male:		
	Female:		
Skill-independent Worker	Male:		
	Female:		

8.4. Are any foreign workers/ experts working in your industry? (Yes/ No) If yes, in which sectors?

8.5. Do you think foreign workers/ experts are more skilled in specific sectors than local ones? (Yes/ No) If yes, in which sectors and why?

Mojahid

Abid Hossain

8.6. What type of training module or technical centers do you think you need for better quality of products?

9. Do you have separate quality control unit? (Yes/No) If yes then, how do you check?

10. Environment and Safety

10.1. Do the workers use safety and personal protective equipment during work? (Yes/ No) If yes, which ones?

10.2. What are the wastes produced in your industry?

10.3. Where do you dump the wastes produced in the industry?

Mojahid Abid Hossain Jagjm

10.4. Do you think there is a possibility of environmental pollution due to the technology used by your industry? (Yes/ No) If yes, how?

11. What do you expect from the government?

Interviewer Name: Date: Comments

Mojahid

Abid Hossain

জরিপ ফর্ম -2 (সুপারভাইজারদের জন্য)

শিরোনাম: যশোর লাইট ইঞ্জিনিয়ারিং এস এম ই এর ক্ষেত্রে কর্মদক্ষতা এবং ব্যবহারিত প্রযুক্তির বর্তমান অবস্থা নিরূপণের জন্য প্রশ্নাবলী (সুপারভাইজারদের জন্য)

সুপ্রিয় তথ্যদাতা, এই গবেষণামূলক কাজটি যশোরের Light Engineering Small And Medium Enterprises (SMEs) এর উপর করা হচ্ছে। আপনার সহযোগিতার জন্য ধন্যবাদ। আপনার মূল্যবান তথ্য আমাদেরকে এই সেক্টরের উন্নয়নের জন্য করনীয় নির্ধারণে সহায়তা করবে। আপনার দেয়া তথ্য শুধুমাত্র গবেষণামূলক কাজে ব্যবহার করা হবে।

১. নাম:

২. প্রতিষ্ঠানের নাম:

৩. ঠিকানা:

৪. জরিপে অংশগ্রহণকারীর তথ্য:

৪.১. লিঙ্গ: (a) পুরুষ (b) মহিলা

৪.২. বয়স: (a) <২০ (b) ২০-৩০ (c) ৩০-৪০ (d) ৪০-৫০ (e) >৫০

৪.৩. পড়াশুনা: (a) প্রাইমারী (b) এসএসসি (c) এইচএসসি (d) স্নাতক (e) স্নাতকোত্তর

৫. পণ্য ও উৎপাদন সংক্রান্ত তথ্য:

৫.১. পণ্যের নাম :

৫.২. পণ্যের মান : (a) খুব খারাপ (b) খারাপ (c) মাঝারী (c) ভাল (d) খুব ভাল

৫.৩. পণ্যের গ্রাহক (ইন্ডাস্ট্রি) : (a) টেক্সটাইল (b) অটোমোবাইল (c) অন্যান্য.....

৬. প্রযুক্তিগত তথ্য:

৬.১. প্রযুক্তি/ যন্ত্রপাতি:

প্রযুক্তির নাম	পরিমাণ	প্রকার	উৎস	বর্তমান অবস্থা	মেরামতের ধরণ ও ফ্রিকুয়েন্সি

৬.২. আপানার ওয়ার্কশপে/ ইন্ডাস্ট্রিতে যেসকল টুল লাগে তার তালিকা দিন:

Mojahid Abidhossain Jasim

৬.৩. আপনি কি আপনার কাজের সাথে সম্পৃক্ত নতুন প্রযুক্তি সম্পর্কে জানেন? (হ্যা/ না) যদি হ্যা হয়, তবে কোনগুলো?

৬.৪. আপনি কাজের সময় মুলত কোন প্রতিবন্ধকতাগুলোর সম্মুখীন হন?

৭. বর্তমান উৎপাদন প্রক্রিয়ার ফ্লো-চার্ট:

৮. দক্ষতা সংক্রান্ত তথ্য:

৮.১. নির্দিষ্ট কাজে দক্ষতা:

কাজের বিবরণ	দক্ষতার পরিমাপ					
	০ (পারি না)	১ (খুব খারাপ)	২ (খারাপ)	৩ (মাঝারী)	৪ (ভাল)	৫ (খুব ভাল)

Mojahid

Abidhossain

৮.২. ট্রেনিং/উৎকর্ষমূলক কার্যকলাপ:

কাজের নাম	অভ্যন্তরীণ ট্রেনিং	বাইরের ট্রেনিং	ট্রেনিং সেন্টারের নাম

৮.৩. মানবশক্তির বিবরণ:

বিভাগ	লিঙ্গ	পড়াশুনা	ট্রেনিং
ডিপ্লোমা ইঞ্জিনিয়ার	পুরুষ:		
	মহিলা:		
টেকনিশিয়ান	পুরুষ:		
	মহিলা:		
সাধারন শ্রমিক	পুরুষ:		
	মহিলা:		

৮.৪. আপনার প্রতিষ্ঠানে কি বাইরের দেশের কোন শ্রমিক/ বিশেষজ্ঞ কাজ করেন? (হ্যা/ না) যদি হ্যা হয়, কোন কোন সেক্টরে?

৮.৫. আপনি কি মনে করেন বাইরের দেশের শ্রমিক/ বিশেষজ্ঞ দেশের শ্রমিক/ বিশেষজ্ঞ থেকে বেশি দক্ষ? (হ্যা/ না) যদি হ্যা হয়, কোন কোন সেক্টরে এবং কেন?

Mojahid

Abid Hossain

৮.৬. আরও ভাল মানের পণ্য উৎপাদনের জন্য আপনি কি ধরনের ট্রেনিং বা ট্রেনিং সেন্টার প্রয়োজনীয় মনে করেন?

৯. আপনাদের কি নিজস্ব মান নির্ধারণ/ নিয়ন্ত্রন ব্যবস্থা রয়েছে? (হ্যা/ না) যদি হ্যা হয়, আপনারা কীভাবে মান নির্ধারণ করে থাকেন?

১০. পরিবেশ ও নিরাপত্তা সংক্রান্ত তথ্য

১০.১. আপনার কর্মচারীরা কি কাজের সময় প্রয়োজনীয় নিরাপত্তা সরঞ্জাম ব্যবহার করে? (হ্যা/ না) যদি হ্যা হয়, কোনগুলো?

১০.২. আপনার ওয়ার্কশপে/ ইন্ডাস্ট্রিতে উৎপন্ন বর্জ্য কি?

১০.৩. আপনি/ আপনারা আপনাদের ওয়ার্কশপে/ ইন্ডাস্ট্রিতে উৎপন্ন বর্জ্য কোথায়ে ফেলেন?

Mojahid Abidhossain Jazim

১০.৪. আপনি কি মনে করেন আপনাদের কার্যকলাপে পরিবেশ দূষণের সম্ভাবনা আছে? (হ্যা/ না) যদি হ্যা হয়, কীভাবে?

১১. আপনি সরকারের কাছে কি প্রত্যাশা করেন?

তথ্য সংগ্রহকারীর নাম: তারিখ: মন্তব্য:

Mojahid

Abid Hossain

Annex 03- Survey Questionnaire for Workers

Title: Survey Questionnaire on Skill & Technology Gap Assessment of Light Engineering SMEs of Jashore Cluster (For workers)

Dear respondent, this study is related to the light engineering small and medium enterprises (SMEs) of Jashore cluster. The objectives of this study are to get a comprehensive overview of this sector including present condition of this sector and assess the skill and technology gap. We thank you for your kind participation. Your valuable comments and observations will help us to recommend effective strategies for overcoming the skill and technology gap and boosting the growth of this sector further. Your response will be used only for research purpose.

1. Name of the interviewee:

2. Organization name:

3. Address:

4. Interviewee information:

4.1. Gender: (a) Male (b) Female

4.2. Age: (a) Below 20 (b) 20 to 30 (c) 30 to 40 (d) 40 to 50 (e) Above 50

4.3. Education level: (a) Primary (b) Secondary (c) HSC (d) Graduate (e) Post graduate

5. Product and production information:

5.1. Major finished products :

5.2. Quality level of products : (a) Very low (b) Low (c) Medium (c) High (d) Very high

5.3. Target customers (Industry served) : (a) Textile (b) Automobile (c) Others.....

6. Technological information:

6.1. Technologies/ Equipment used:

Name of technology	Quantity	Type (Automatic/semi-automatic/manual)	Source (Local/Imported)	Current condition	Maintenance type with frequency

6.2. List the tools used in your industry/ workshop:

Mojahid Abidhossain

Annex 03- Survey Questionnaire for Workers

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1. Name of the interviewee:

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3. Address:

4. Interviewee information:

4.1. Gender: (a) Male (b) Female

4.2. Age: (a) Below 20 (b) 20 to 30 (c) 30 to 40 (d) 40 to 50 (e) Above 50

4.3. Education level: (a) Primary (b) Secondary (c) HSC (d) Graduate (e) Post graduate

5. Product and production information:

5.1. Major finished products :

5.2. Quality level of products : (a) Very low (b) Low (c) Medium (c) High (d) Very high

5.3. Target customers (Industry served) : (a) Textile (b) Automobile (c) Others.....

6. Technological information:

6.1. Technologies/ Equipment used:

Name of technology	Quantity	Type (Automatic/semi-automatic/manual)	Source (Local/Imported)	Current condition	Maintenance type with frequency

6.2. List the tools used in your industry/ workshop:

Mojahid

Abidhossain

6.3. Do you know about some of the latest technologies related to your work? (Yes/ No) If yes, which ones?

6.3. What are the major technical and technological challenges do you face?

7. Current production process flow chart:

8. Skill related information:

8.1. Skill level of specific job:

Job description	Skill Level					
	0 (Can't do)	1 (Very low)	2 (Low)	3 (Moderate)	4 (High)	5 (Very High)

Mojahid

Abidhossain

8.2. Training and development:

Name of job	Training provided internally	Training provided externally	Name of training center

8.3. Are any foreign workers/ experts working in your industry? (Yes/ No) If yes, in which sectors?

8.4. Do you think foreign workers/ experts are more skilled in specific sectors than you? (Yes/ No) If yes, in which sectors and why?

8.5. What type of training module or technical centers do you think you need for better quality of products?

Mojahid

Abid Hossain

9. Do you have separate quality control unit? (Yes/No) If yes then, how do you check?

10. Environment and Safety

10.1. Do you use safety and personal protective equipment during work? (Yes/ No) If yes, which ones?

10.2. What are the wastes produced in your industry?

10.3. Where do you dump the wastes produced in the industry?

10.4. Do you think there is a possibility of environmental pollution due to the technology used by your industry? (Yes/ No) If yes, how?

Mojahid

Abidhossain

11. What do you expect from the government?

Interviewer Name: Date: Comments:

Mojahid

Abidhossain

জরিপ ফর্ম -৩ (শ্রমিকদের জন্য)

শিরোনাম: যশোর লাইট ইঞ্জিনিয়ারিং এস এম ই এর ক্ষেত্রে কর্মদক্ষতা এবং ব্যবহারিত প্রযুক্তির বর্তমান অবস্থা নিরূপণের জন্য প্রশ্নাবলী (শ্রমিকদের জন্য)

সুপ্রিয় তথ্যদাতা, এই গবেষণামূলক কাজটি যশোরের Light Engineering Small And Medium Enterprises (SMEs) এর উপর করা হচ্ছে। আপনার সহযোগিতার জন্য ধন্যবাদ। আপনার মূল্যবান তথ্য আমাদেরকে এই সেক্টরের উন্নয়নের জন্য করনীয় নির্ধারণে সহায়তা করবে। আপনার দেয়া তথ্য শুধুমাত্র গবেষণামূলক কাজে ব্যবহার করা হবে।

১. নাম:

২. প্রতিষ্ঠানের নাম:

৩. ঠিকানা:

৪. জরিপে অংশগ্রহণকারীর তথ্য:

৪.১. লিঙ্গ: (a) পুরুষ (b) মহিলা

৪.২. বয়স: (a) <২০ (b) ২০-৩০ (c) ৩০-৪০ (d) ৪০-৫০ (e) >৫০

৪.৩. পড়াশুনা: (a) প্রাইমারী (b) এসএসসি (c) এইচএসসি (d) স্নাতক (e) স্নাতকোত্তর

৫. পণ্য ও উৎপাদন সংক্রান্ত তথ্য:

৫.১. পণ্যের নাম :

৫.২. পণ্যের মান : (a) খুব খারাপ (b) খারাপ (c) মাঝারী (c) ভাল (d) খুব ভাল

৫.৩. পণ্যের গ্রাহক (ইন্ডাস্ট্রি) : (a) টেক্সটাইল (b) অটোমোবাইল (c) অন্যান্য.....

৬. প্রযুক্তিগত তথ্য:

৬.১. প্রযুক্তি/ যন্ত্রপাতি:

প্রযুক্তির নাম	পরিমাণ	প্রকার	উৎস	বর্তমান অবস্থা	মেরামতের ধরণ ও ফ্রিকুয়েন্সি

Mojahid Abid Hossain

৬.২. আপানার ওয়ার্কশপে/ ইন্ডাস্ট্রিতে যেসকল টুল লাগে তার তালিকা দিন:

৬.৩. আপনি কি আপনার কাজের সাথে সম্পৃক্ত নতুন প্রযুক্তি সম্পর্কে জানেন? (হ্যা/ না) যদি হ্যা হয়, তবে কোনগুলো?

৬.৪. আপনি কাজের সময় মুলত কোন প্রতিবন্ধকতাগুলোর সম্মুখীন হন?

৭. বর্তমান উৎপাদন প্রক্রিয়ার ফ্লো-চার্ট:

Mojahid

AbidHossain

৮. দক্ষতা সংক্রান্ত তথ্য:

৮.১. নির্দিষ্ট কাজে দক্ষতা:

কাজের বিবরণ	দক্ষতার পরিমাপ					
	০ (পারি না)	১ (খুব খারাপ)	২ (খারাপ)	৩ (মাঝারী)	৪ (ভাল)	৫ (খুব ভাল)

৮.২. ট্রেনিং/উৎকর্ষমূলক কার্যকলাপ:

কাজের নাম	অভ্যন্তরীণ ট্রেনিং	বাইরের ট্রেনিং	ট্রেনিং সেন্টারের নাম

৮.৩. আপনার প্রতিষ্ঠানে কি বাইরের দেশের কোন শ্রমিক/ বিশেষজ্ঞ কাজ করেন? (হ্যা/ না) যদি হ্যা হয়, কোন কোন সেক্টরে?

Mojahid

Abidhossain

৮.৪. আপনি কি মনে করেন বাইরের দেশের শ্রমিক/ বিশেষজ্ঞ দেশের শ্রমিক/ বিশেষজ্ঞ থেকে বেশি দক্ষ? (হ্যা/ না) যদি হ্যা হয়, কোন কোন সেক্টরে এবং কেন?

৮.৫. আরও ভাল মানের পণ্য উৎপাদনের জন্য আপনি কি ধরনের ট্রেনিং বা ট্রেনিং সেন্টার প্রয়োজনীয় মনে করেন?

৯. আপনাদের কি নিজস্ব মান নির্ধারণ/ নিয়ন্ত্রন ব্যবস্থা রয়েছে? (হ্যা/ না) যদি হ্যা হয়, আপনারা কীভাবে মান নির্ধারণ করে থাকেন?

১০. পরিবেশ ও নিরাপত্তা সংক্রান্ত তথ্য

১০.১. আপনি কি কাজের সময় প্রয়োজনীয় নিরাপত্তা সরঞ্জাম ব্যবহার করে? (হ্যা/ না) যদি হ্যা হয়, কোনগুলো?

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১০.২. আপনার ওয়ার্কশপে/ ইন্ডাস্ট্রিতে উৎপন্ন বর্জ্য কি?

১০.৩. আপনি/ আপনারা আপনাদের ওয়ার্কশপে/ ইন্ডাস্ট্রিতে উৎপন্ন বর্জ্য কোথায়ে ফেলেন?

১০.৪. আপনি কি মনে করেন আপনাদের কার্যকলাপে পরিবেশ দূষণের সম্ভাবনা আছে? (হ্যা/ না) যদি হ্যা হয়, কীভাবে?

১১. আপনি সরকারের কাছে কি প্রত্যাশা করেন?

তথ্য সংগ্রহকারীর নাম: তারিখ: মন্তব্য:

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Annexure 04

Figure A1: Focus Group Discussion with Foundry Owners

Figure A2: Focus Group Discussion with Machining Industry Owners

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Figure A3: Focus Group Discussion with Workers

Figure A4: Interview with Owner

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Figure A5: Interview with Worker

A6: Interview with Indian Consultant

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Figure A7: Validation workshop (Workshop owners)

Figure A8: Validation workshop (Experts on Zoom Meeting)

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Terms of Reference (ToR)
for

Study on 'Exploring Capability and Identifying Skill & Technology Gap of Jashore Light Engineering SMEs'

1. Background:

Small and Medium Enterprises (SMEs) are recognized worldwide as a strategic agent of economic and social development through employment creation, income generation and poverty alleviation. The Government of Bangladesh established the Small and Medium Enterprise Foundation (SME Foundation) under Ministry of Industries as an apex institution for SME development in the country. Since its inception, SME Foundation has implemented multifaceted development interventions to promote growth of SMEs and enabling them face challenges of free market economy and globalization. As most SMEs are located in geographical dense locations called 'Cluster'; it is of prime importance to understand existing situation, identify problems and potentials of SME clusters in order to design appropriate interventions for their development. SME Foundation has identified 177 naturally grown SME clusters across the country and planned to conduct needs assessment followed by implementation of development interventions.

Light Engineering Industry (LEI) is considered as the mother of all SME segments in Bangladesh and has been highlighted in the National Industrial policy 2016 as one of the highest priority sectors. The sector is suffering from technological obsolescence, low productivity, lack of market linkage, etc. Major LES clusters are located in Dhaka, Chattogram, Bogura and Jashore.

The purpose of the study is to in terms assess technological situation of Jashore Light Engineering Cluster. The study will also emphasize export potential, value chain development and opportunity for sub-contracting & production networking for the cluster.

2. Objective:

The objectives of the study are:

(i) To explore present capability and future potential of the cluster;
(ii) To identify gap and constraints to development of the cluster; and
(iii) To prepare time-bound development strategies & interventions for the cluster.

3. Scope of Work:

The study intends to perform a detailed technological situation assessment of Jashore Light Engineering Cluster. The study should collect, interpret and forecast information to understand the cluster dynamics. The scope of work will include, but not limited to, the following tasks:

(i) Collect Cluster Information
   a. Geographic Location, Area, Boundary
   b. Entrepreneurs, Enterprises and Nature of Ownership
   c. Infrastructure and Utility Service
   d. Employment (amount, age, sex, education, skill, trend)
   e. Annual Turnover
   f. Business Organizations (Chamber/ Association and their membership)

(ii) Collect Raw Material Information
   a. List of Raw Materials (by Type, Source, Purpose)
   b. Annual Consumption/ Demand
   c. Annual Supply/ Availability (Suppliers, Trend)

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(iii) Collect Product and Production Information
   a. Major Products and Quality Level
   b. Industries Served
   c. Annual Production

(iv) Assess Technology Situation
   a. Existing Technology in the Cluster
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)
   b. Process Flow Chart
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)
   c. Current Technology used in Operation Steps
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)
   d. Status of Global Technology
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)
   e. Technology Gap
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)

(v) Major Challenges and Suggestive Measures to Bridge Technology Gap
   a. Technology Trends
      i. Foundry Industries (Casting)
      ii. Machining Industries (Milling and Turning)
   b. Technological Challenges and Technical Issues
   c. Cluster and its People
   d. Government Policies and Economic Factors
   e. Safety and Environment Aspects
   f. Suggestive Measures to Bridge Technology Gap

(vi) Strategic Direction of Action Plan
   a. SWOT Analysis of the cluster
   b. Potential Action Plan
      i. Manufacturing Technology Up-gradation
      ii. Networking
      iii. Business Development Service (BDS) Provider Development
      iv. Product / Market Diversification
   c. Priority Activities

4. Task Specification:

The consulting institute/ firm shall be responsible for conducting (not limited to):

(i) Introductory visit to the cluster and meeting with at least 5 cluster actor groups (3-4 members from each group)

(ii) Focus Group Discussions (FGDs) in the cluster with cluster actor groups, consisting not more than fifteen (15) members

(iii) Questionnaire Survey of about 10% of cluster SMEs by product category and enterprise size to collect cluster data and information

(iv) Structured questionnaire interviews (one to one) of 20 sector players/ actors

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(v) At least 10 Key Informant Interviews (KII) of national/ local level stakeholders (retailer/ buyer/ bank manager/ supplier/ researcher/ regulatory expert/ exporter/ pioneer entrepreneur/ association leader/ journalist/ academician etc.) in the cluster

(vi) The consulting institution/ firm will propose a Methodology complying with the specific objectives. Special weightage would be given to a standard methodology.

(vii) The consulting institution/ firm shall finalize the questionnaires and meeting schedule in consultation with SME Foundation.

(viii) The definition of SME should follow the definition as per Industrial Policy-2016

(ix) The consulting institution/ firm shall also be liable for desk research and identify any inconsistent regulations/policies that are impeding the growth of the clusters.

(x) The consulting institution/ firm should identify institutional capacity building requirements for the promotion of the clusters.

(xi) The consulting institution/ firm shall submit all strategic documents related to survey, meetings, data analysis and so forth.

(xii) The consulting institution/ firm shall present the key findings to the stakeholders.

(xiii) The consulting institution/ firm must propose price inclusive of tax and VAT. SME Foundation shall reserve the right to cancel the proposal if it is not tax and VAT inclusive.

(xiv) The consulting institution/ firm shall be responsible to provide scholarly inputs to the reports for next one year, if required.

(xv) At least one representative from SME Foundation shall be present in the meetings.

(xvi) The consulting institution/ firm under no circumstances can sub-contract any or all activities to any other entity or incorporate any individual outside of the research team.

5. Requirements of Field Visit:

(i) Primary visit in the cluster shall be conducted by TEAM LEADER and research team to find out the current situation of the cluster and fix the date of additional activities. All primary visits shall be conducted within two weeks from signing the agreement. Primary visits shall be conducted by the field coordinator of the research team within one (01) day. After primary visit, inception report, the detail task proposal and name of the field visit team members should be provided.

(ii) Focus Group Discussions (FGDs) in the cluster shall be conducted by TEAM LEADER and research team to collect data after the primary visit. Before conducting the FGDs, the research team will meet the key actors of the cluster. The collected data shall be validated by the members of the focus groups after conducting focus group discussions. Representative from SME Foundation may be present in focus group discussions. The schedule of all of the focus group discussions shall be approved by SME Foundation after primary visit. Customized questionnaire shall be prepared by the team for the cluster after primary visits which shall be validated by SME Foundation.

(iii) Structured questionnaire interviews of cluster actors/ sector players and key informant interviews shall be conducted by TEAM LEADER and research team. Each member of the field research team must participate individually to take interviews.

(iv) Focus Group Discussions, key informant interviews and case study of the cluster shall be conducted by all the members of research team within two (02) days.

(v) Focus Group Discussions, key informant interviews and case study of each cluster has to be conducted under the direct supervision of the 'TEAM LEADER'.

(vi) The schedule of all activities (survey, KII, FGD, etc.) should be fixed with consultation and written permission of SME Foundation. The documents used for data collection should be validated by SME Foundation.

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(vii) After each successful data collection/KII/FGD/or such event the research team must organize an informal meeting with team members and SME Foundation representative, if possible.

6. Team Composition:

(i) The research team shall be led by a Senior Researcher / Professor / Associate Professor (PhD holders) referred as 'Team Leader' to guide, monitor, evaluate and analyze the entire process.

(ii) The team must include at least two mid-level Researcher / Associate Professor / Assistant Professor for associated activities.

(iii) CVs of all team members must be submitted with proposal.

7. Deliverables:

Followings are the deliverables of this study which will be produced or arranged by the consulting firm:

(i) Inception report with incorporation of SMEF recommendations
(ii) Draft Final Report with incorporation of SMEF recommendations.
(iii) Final report with incorporation of recommendations from validation workshop.
(iv) Three presentations (namely, a. Inception report, b. Draft final report, c. Final report).
(v) Hard and soft copy (in a CD or DVD) of all reports and presentations.
(vi) All documents (list, attendance sheet, filled-in questionnaires, meeting/KII documents, data analysis sheet, database, etc.).

8. Reporting Obligation:

(i) The written reports are expected to respond to all tasks identified in the Terms of Reference. Each report shall be based on qualitative and quantitative data.

(ii) All sorts of coordination and communication shall take place between the Consulting firm/ institution's authorized representative and authorized official of SME Foundation.

(iii) Delivery of three presentations (namely, a. Inception report, b. Draft final report, c. Final report) shall be determined through written communication between the consulting firm/ institution and SME Foundation.

(iv) Final report shall be presented before the SME Foundation authority and relevant stakeholders in a validation workshop arranged at a suitable venue decided by SME Foundation. The validation workshop shall be organized by consulting firm/ institute for validating the final report. All expenses related to validation workshop shall be borne by the consulting firm/ institute.

(v) Remuneration of the experts to be invited in final report validation workshop @ BDT 2,000 per person shall be paid by the awarding firm (Approximately 35 experts). It should be noted that the number of experts and remuneration may vary according to decision of the SME Foundation.

(vi) Necessary amendments, updates, changes shall be completed and documented by the consulting firm/ institute as per the instruction/direction of SME Foundation authority and stakeholders during validation workshops and other presentations as well.

9. Reporting Specification:

The written report is expected to respond to all tasks identified in the Terms of Reference. The standard format of the final report shall include:

(i) Title Page (authors, date, activity, location).
(ii) Executive Summary (including background, key findings, methodology, recommendations).

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(iii) Main body of the report with description of the background, the stakeholders, methodology (including participants list, contact details, at which level of research did he/she participated etc.), results of analyses, findings, the key issues, recommendations and conclusion.

(iv) Appendices, Glossary, acronyms, Terms of Reference, list of participants and sources of data, diagrams, drawings, photographs.

10. Time Frame:

The total duration of implementation of the task should not exceed 3 months after awarding the task. The detailing of the time-bound activities is given below:

Sl.	Activity	Duration											
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
1.	Literature review												
2.	Study planning												
3.	Submission of Inception Report												
4.	Conduction of study												
5.	Submission of draft final report												
6.	Necessary Amendment, Updates, Changes												
7.	Validation Workshop (Presentation of Final Report)												
8.	Necessary Amendment, Updates, Changes												
9.	Final Report Submission												

*N.B.: W1 = Week 1, and so on.

11. Mode of Payment:

First installment:	Thirty (30) percent of the Contract Price shall be paid upon after acceptance of the inception report by the SMEF authority.
Second installment:	Thirty (30) percent of the Contract Price shall be paid upon after acceptance of the draft final report by the SMEF authority.
Final installment :	Forty (40) percent of the Contract Price shall be paid upon after acceptance of the final report by the SMEF authority.

** VAT and Tax will be deducted as per VAT Act and Income Tax Ordinance.*

12. General Guidelines:

(i) The governing language shall be English.

(ii) All payments shall be done through account payee check in favor of the consulting firm / institution.

(iii) Date of presenting inception report, draft report and final report shall be determined through written consultation with both the authorities.

(iv) A printed version and a soft copy of the final report shall have to be submitted to SME Foundation within the specified time frame.

(v) SME Foundation shall reserve all rights for adding any dimension for better output from the study.

(vi) The SME Foundation reserves the right to accept or reject any or all bids in part or in full without assigning any reason.

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