Pre-feasibility Study

MANUFACTURING UNIT FOR ELECTRIC MOTORS

October 2022

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Small and Medium Enterprises Development Authority
Ministry of Industries and Production
Government of Pakistan

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2. EXECUTIVE SUMMARY

An electric motor is used to convert electrical energy into mechanical energy. Different types of electric motors are used for different applications. Selecting the right type of electric motor is essential for efficient functioning of industrial and household operations. There are two broad types of electric motors, i.e. AC motors and DC motors. AC stands for Alternating Current and DC stands for Direct Current. AC motors are powered by alternating current while DC motors are powered by direct current. Common types of AC and DC motors are listed below:

Types of AC Motors

- Induction Motors
- Synchronous Motors

Types of DC Motors

- Permanent Magnet DC Motors
- Series DC Motors
- Shunt DC Motors
- Compound DC Motors

Electric motors are also categorized as single phase or three phase motors. Single phase motor works by using a single-phase power supply. These motors mostly find their use in domestic appliances and lighter loads such as blowers, vacuum cleaners, fans, centrifugal pumps, washing machines, grinders, drilling machines compressors, etc. Whereas three phase motor works by using a three-phase power supply. The three-phase motors are mostly used in industrial and commercial applications since they are more rugged and economical in terms of operational efficiencies. Common applications include lifts, cranes, hoists, large capacity exhaust fans, driving lathe machines, crushers, oil extracting mills, textile machines, etc.

The demand for single phase motors is more than three single phase motors as these are used in houses and industries for a load below 5KW. Manufacturing unit for single phase electric motors requires less investment than that required for three phase electric motors. A complex and large setup is required for three phase electric motors. The proposed unit targets household, commercial and smaller industrial markets. Single-phase connections are mostly intended for domestic supplies and residential homes.

AC motors (single phase induction motors and synchronous motors) are used as a power source to drive different types of machines such as pumps, food and beverage machines, automated conveyer equipment, packaging operations, washing machines, electric knife sharpeners, office equipment, ovens, water heaters etc. DC motors are usually used for smaller applications, such as mechanical tools, toys and different types of smaller household appliances. In retail, the applications of DC motors include conveyors and turntables, while in an industrial setting, large DC motor uses also include braking and reversing applications.

AC motors are generally considered to be more powerful than DC motors because they can generate higher torque by using a more powerful current. AC motor has following advantages over DC motor:

- Lower startup power demand
- Better control over starting current levels and acceleration
- Broader customizability for different configuration requirements and changing speed and torque requirements
- Greater durability and longevity

Materials used for manufacturing electric motors generally include iron, nickel, and cobalt. Iron is the cheapest of these three materials. Cobalt is rarely used as a standalone material and is sometimes added to iron to add certain characteristics. Basic pig iron[1] is the most commonly used material for manufacturing electric motors. It is used since it is reliable, easily available, cost-effective and durable. The unit is proposed to manufacture two types of AC electric motors i.e., induction motors and synchronous motors, using pig iron as the basic raw material.

This Pre-Feasibility Document provides details for setting up a "Manufacturing Unit for AC Electric Motors" (induction motors and synchronous motors). The manufacturing unit is proposed to be located in large cities like Karachi, Lahore, Islamabad, Peshawar, Rawalpindi, Quetta, Faisalabad, Sialkot, Hyderabad, Multan, Faisalabad, Sukkur, Gujranwala, or any other major city of Pakistan. These cities are suitable because of the presence of large number of industrial units. Easy availability of raw materials and skilled labor are the other important factors to make these locations suitable for establishing this manufacturing business. Growing number of industrial units in the country is leading to an increased the demand of electric motors.

The proposed project has an annual capacity of manufacturing 33,600 motors (including 16,800 1HP induction motors, 7,200 2HP induction motors, 7,200 1HP synchronous motors and 2,400 2HP synchronous motors). Capacity utilization, in the first year of operations, is assumed to be 50% which translates into production of 16,800 motors (including 8,400 1HP induction motors, 3,600 2HP induction motors, 3,600 1HP synchronous motors and 1,200 2HP synchronous motors). Maximum capacity utilization is assumed to be 90% (30,240 motors) to be achieved in the 9th year of operations.

The proposed project will be set up in a rented building having an area of 6,750 square feet. The proposed unit requires a total investment of PKR 22.55 million. This includes capital investment of PKR 16.00 million and working capital of PKR 6.54 million. This

[1] Pig iron has more carbon content (4%) as compared to cast iron (3%) and is not brittle. Pig iron contains many impurities like Sulphur, Phosphorus, Silicon and Manganese, while cast iron does not contain any impurity and can be cast into any shape.

project is financed through 100% equity. The Net Present Value (NPV) of project is PKR 70.68 million with an Internal Rate of Return (IRR) of 63% and a Payback period of 2.51 years. Further, the proposed project is expected to generate Gross Annual Revenues of PKR 158.46 million in 1st year of operations, Gross Profit (GP) ratio ranging from of 18% to 23% and Net Profit (NP) ratio ranging from 3% to 13% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at capacity of 30% (10,053 motors) with breakeven revenue of PKR 94.82 million in a year.

The proposed project may also be established using leveraged financing. With 50% debt financing at a cost of KIBOR+3%, the proposed unit provides Net Present Value (NPV) of PKR 84.89 million, Internal Rate of Return (IRR) of 61% and Payback period of 2.61 years. Further, this project is expected to generate Net Profit (NP) ratio ranging from 2% to 13% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at capacity of 31% (10,491 motors) with breakeven revenue of PKR 98.96 million.

The proposed project will provide employment opportunities to 39 people. The legal status of this business is proposed as “Sole-Proprietorship”.

3. INTRODUCTION TO SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with an objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in employment generation and value addition to the national income, through development of the SME sector, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out ‘sectorial research’ to identify policy, access to finance, business development services, strategic initiatives and institutional collaboration and networking initiatives.

Preparation and dissemination of prefeasibility studies in key areas of investment has been a successful hallmark of SME facilitation by SMEDA.

Concurrent to the prefeasibility studies, a broad spectrum of business development services is also offered to the SMEs by SMEDA. These services include identification of experts and consultants and delivery of need-based capacity building programs of different types in addition to business guidance through help desk services.

National Business Development Program for SMEs (NBDP) is a project of SMEDA, funded through Public Sector Development Program of Government of Pakistan.

The NBDP envisages provision of handholding support / business development services to SMEs to promote business startup, improvement of efficiencies in existing SME value chains to make them globally competitive and provide conducive business environment through evidence-based policy-assistance to the Government of Pakistan. The Project is objectively designed to support SMEDA's capacity of providing an effective handholding to SMEs. The proposed program aimed at facilitating around 314,000 SME beneficiaries over a period of five years.

4. PURPOSE OF THE DOCUMENT

The objective of the pre-feasibility study is primarily to facilitate potential entrepreneurs in project identification for investment. The project pre-feasibility may form the basis of an important investment decision and in order to serve this objective, the document/study covers various aspects of project concept development, start-up, and production, marketing, finance and business management.

The purpose of this document is to provide information to the potential investors about establishing a “Manufacturing Unit for Electric Motors”. The document provides a general understanding of the business to facilitate potential investors in crucial and effective investment decisions.

The need to come up with pre-feasibility reports for undocumented or minimally documented sectors attains greater imminence as the research that precedes such reports reveal certain thumb rules; best practices developed by existing enterprises by trial and error, and certain industrial norms that become a guiding source regarding various aspects of business setup and its successful management.

Apart from carefully studying the whole document one must consider critical aspects provided later on, which form the basis of any investment decision.

5. BRIEF DESCRIPTION OF PROJECT & PRODUCTS

This document provides details for setting up a “Manufacturing Unit for AC Electric Motors (Single phase Induction and Synchronous Motors)”. AC electric motor is a very important machine in modern-day life. General uses for AC motors include pumps, lawn and garden equipment, food and beverage machines, automated conveyer equipment, packaging operations, washing machines, electric knife sharpeners, office equipment, ovens, water heaters, and off-road motorized equipment etc. AC motors are ideal for industrial and residential applications. AC motors are also preferred for compressor power drives, steel mill rolling equipment, paper machines, air conditioning compressors and hydraulic and irrigation pumps, etc. Two main types of AC motors, are induction motors and synchronous motors, which have been included as part of this study and are discussed below:

Induction Motor

An induction motor or asynchronous motor is an AC electric motor in which electric current is obtained by electromagnetic induction from the magnetic field of the stator winding for producing torque.[2] An induction motor can therefore be made without electrical connections to the rotor.[3] Electrical connections, requiring mechanical

[2] The torque output of a motor is the amount of rotational force that the motor develops.
[3] The rotor is a moving component of an electromagnetic system in the electric motor.

commutation, separate-excitation or self-excitation for all or part of the energy transferred from stator[4] to rotor are not required in induction motors, as are required in DC and synchronous motors. Induction motors are used mostly for domestic and commercial purposes, and sometimes also for industrial purposes. Induction motors are used in pumps, compressors, fans, mixers, high-speed vacuums and drilling machines. An induction motor's rotor is squirrel-cage type. Figure 1 shows an induction motor.

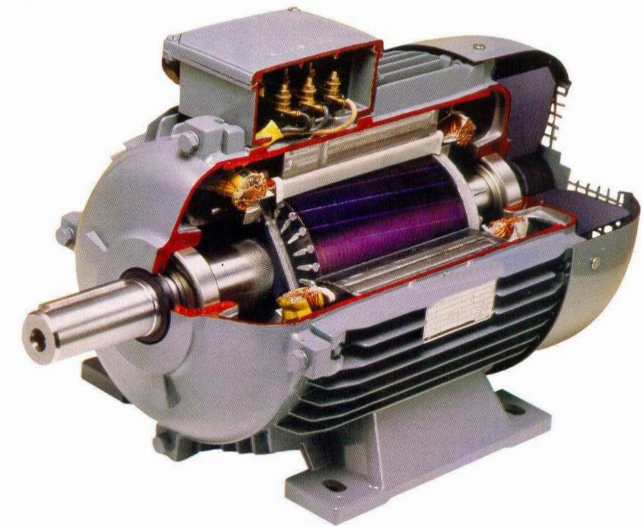
Figure 1: Induction Motor

Synchronous Motor

A synchronous electric motor is an AC electric motor in which, at steady state, the rotation of the shaft is synchronized with the frequency of the supply current, and the rotation period is exactly equal to an integral number of alternating current (AC) cycles. Synchronous motors contain multiphase AC electromagnets on the stator of the motor which create a magnetic field, which rotates in time with the oscillations of the line current. The rotor with permanent magnets or electromagnets turns in step with the stator field at the same rate and as a result, provides the second synchronized rotating magnet field of any AC motor. Synchronous motors are used in wireless and radio communication installations, recording devices, electric clocks and synchronous servosystems etc. A further use is in the aircraft industry where AC frequencies are normally around 400 Hz. Figure 2 shows synchronous motor.

[4] The stator is the stationary part of a rotary system, found in electric generators and electric motors. Energy flows through a stator to or from the rotating component of the system

Figure 2: Synchronous motor



The fundamental difference between these two types of motors is that the speed of the rotor, relative to the speed of the stator, is equal for synchronous motors, while the rotor speed in induction motors is less than its synchronous speed. This is why induction motors are also known as asynchronous motors.

The asynchronous nature of induction motors creates slip (the difference between the rotating speed of the shaft and the speed of the motor's magnetic field), which allows for increased torque. Induction motors are powered at the stator, while the rotor induces current. Synchronous motors experience no slip because the stator and rotor are in sync and require an external AC power source. Table 1 shows the differences between induction motor and synchronous motor.

Table 1: Difference between Induction Motor and Synchronous Motor

Particulars	Induction Motor	Synchronous Motor
Type of Excitation	An induction motor is a single excited machine.	A synchronous motor is a doubly excited machine.
Supply System	Its stator winding is energized from an AC source.	Its armature winding is energized from an AC source and its field winding from a DC source.
Speed	If the load is increased, the speed of the induction motor decreases. It is always less than the synchronous speed.	It always runs at synchronous speed. The speed is independent of load.
Starting	Induction motor has self starting torque.	It is not self starting. It has to be run up to synchronous speed by any means before it can be synchronized to AC supply.

Operation	An induction motor operates only at a lagging power factor. At high loads, the power factor becomes very poor.	A synchronous motor can be operated with lagging and leading power by changing its excitation.
Usage	An induction motor is used for driving mechanical loads only.	It can be used for power factor correction in addition to supplying torque to drive mechanical loads.
Efficiency	Its efficiency is lesser than that of the synchronous motor of the same output and the voltage rating.	It is more efficient than an induction motor of the same output and voltage rating.
Cost	An induction motor is cheaper than the synchronous motor of the same output and voltage rating.	A synchronous motor is costlier than an induction motor of the same output and voltage rating

Single Phase and Three Phase Electric Motors

Electric motors are also categorized as single phase or three phase motors. Single phase motor works by using a single-phase power supply. These motors mostly find their use in domestic appliances and lighter loads such as blowers, vacuum cleaners, fans, centrifugal pumps, washing machines, grinders, drilling machines compressors, etc. Whereas three phase motor works by using a three-phase power supply. The three-phase motors are mostly used in industrial and commercial applications since they are more rugged and economical in terms of operational efficiencies. Common applications include lifts, cranes, hoists, large capacity exhaust fans, driving lathe machines, crushers, oil extracting mills, textile machines, etc.

The demand for single phase motors is more than three single phase motors as these are used in houses and industries for a load below 5KW. Manufacturing unit for single phase electric motors requires less investment than that required for three phase electric motors. A complex and large setup is required for three phase electric motors. The proposed unit targets household, commercial and smaller industrial markets. Single-phase connections are mostly intended for domestic supplies and residential homes. Table 2 shows the difference between single phase and three phase motor.

Table 2: Difference between Single Phase Motor and Three Phase Motor

Particulars	Single-Phase Motor	Three-Phase Motor
Features	The single-phase motor is simple in construction, reliable and economical compared to three-phase induction motors.	The three-phase motor is complex in construction and costly.
Maintenance	The single-phase motor is easy to repair and maintain.	The three-phase motor is difficult to repair and maintain.
Size (for same power rating)	The single-phase motor is larger in size.	The three-phase motor is smaller in size.
Structure	The single-phase motor is simple and easy to manufacture.	The three-phase motor is more complicated to construct.
Motor rotation	In the single-phase motor, there is no mechanism to change the rotation.	The rotation of the three-phase motor can be changed easily by changing the phase sequence in the stator.
Output voltage levels	The single-phase motor delivers a voltage level of almost 220V.	The three-phase motor delivers a voltage level of almost 420-440V.
Starting torque	The single-phase motor offers a very limited starting torque.	The three-phase motor offers very high starting torque.
Power rating	The single-phase motor is made for low power rating usually below 5KW.	The three-phase motor is made for power rating above 5KW.

5.1 Machinery and Equipment

The machinery and equipment used in the proposed project is described in the following paragraphs:

Gas Furnace

A furnace is used to melt the pig iron required for casting different parts of a motor. The gas furnace used in proposed project consists of furnace body, control panel and a tilting control box. It has a self-test function and leaking alarm device, real-time detection of temperature and pressure. Gas furnace used in the proposed project has a capacity of melting 120 kg pig iron per hour and is shown in Figure 3.

Figure 3: Gas Furnace

Sand Casting Equipment and Tools

Sand casting process requires the following equipment and tools:

- **Iron Flask**

The flask is a metal frame, which contains the molding sand, providing support to the sand as the metal is poured into the mold. Figure 4 shows iron flask.

Figure 4: Iron Flask

- **Soil or Sand Sifter**

A sifter is a tool that separates particles of a substance by size. Since soil is a mixture of rock particles of different sizes, it can be helpful to separate soils for the purpose of reuse. Soil sifter cleans the soil, removing large organic objects such as rocks and debris like broken glass. The process improves the texture of the soil. Soil sifter is used for the fine sifting of foundry sand onto the mold surface. This ensures uniform coverage to prevent casting defects. Different sizes of soil sifter are available in the market. Figure 5 shows soil sifter.

Figure 5: Soil or Sand Sifter

- **Shovel**

A shovel is a tool for digging, lifting and moving bulk materials such as soil, coal, gravel, snow, sand, etc. Most shovels are hand tools consisting of a broad blade fixed to a medium-length handle. Shovel blades are usually made of sheet steel and are very strong. Figure 6 shows shovel.

Figure 6: Shovel

- **Hand Trowel**

A trowel is a small hand tool used for digging, applying, smoothing or moving small amounts of viscous or particulate material. Figure 7 shows hand trowel.

Figure 7: Hand Trowel

- **Hand Rammer**

A hand rammer, also termed as tamper, is a hand tool used for compressing or compacting sand. Sand is compressed or compacted to make it hard and of uniform level. Figure 8 shows a Hand Rammer.

Figure 8: Hand Rammer

- **Sprue Pins**

Sprue pin is a tapered rod of wood or iron, which is embedded in the sand and later withdrawn to produce a hole, called runner, through which the molten metal is poured into the mold. Figure 9 shows sprue pins made of iron.

Figure 9: Sprue Pins

- **Strike-off Bar**

Strike-off bar is a metallic bar used to remove excess material from mold. It is used as a finishing tool for removing loose sand from mold. Figure 10 shows a strike off bar.

Figure 10: Strike off bar

- **Mallet**

A mallet is a tool used for striking the sand mass in the molding box to pack it closely around the pattern. These are often made of rubber or sometimes wood that is smaller than a maul or beetle and usually has a relatively large head.

Figure 11: Mallet

- **Manual Pallet Jack**

A manual pallet jack is a hand-powered jack used for lifting, lowering and steering pallets and heavy loads from one place to another. Figure 12 shows a manual pallet jack having a load capacity of 1000 kilograms.

Figure 12: Manual Pallet Jack

Smoother (finishing tool)

Smoother is a flat device used to give a flat, regular surface of sand on the mold. The smoother is made of metal, plastic or wood. Figure 13 shows a plastic smoother.

Figure 13: Smoother

- **Gate Cutter**

Gate Cutter is used to cut the sprues or runners from a part after the molding process. Figure 14 shows a gate cutter.

Figure 14: Gate Cutter

Shot Blasting Machine

A Shot blasting machine is an enclosed equipment designed for abrasive blasting[5] for cleaning and preparing metals. It is a machine for shot peening,[6] cleaning metal parts such as forgings, castings, steel surfaces, heavy metal structures, rusted metal parts, etc. Shot blasting machine uses blast metal shots (as a medium) on the metal parts in an enclosed chamber to remove surface rust, welding slag and descaling, making it uniform, shiny and improve coating quality of anti-rust chemicals. Shot blasting machine used in the proposed project have a capacity of blasting 120 kg of metal products per hour. Figure 15 shows shot blasting machine.

Figure 15: Shot Blasting Machine

[5] Abrasive blasting entails accelerating a grit of sand sized particles with compressed air to provide a stream of high velocity particles used to clean metal objects.
[6] The shot peening process is used to add strength and reduce the stress profile of components.

The metal shots used for shot blasting are steel shots as shown in Figure 16.

Figure 16: Steel Shots used for Shot Blasting

Bench Grinder

A bench grinder consists of powerful grinding wheels, used to perform different tasks. Different sizes of grinding wheels are used (generally from 6 to 10 inches) with varying grits for different types of jobs. Grit refers to the size of the abrasive particles embedded in the wheel. Different grades are used to identify the grits. Grinding wheels usually lie between between 24 grade grit and 100 grade grit. This grinder is installed on a bench or work table where the work piece is held against the grinding wheel to allow for a varying degree of sharpening shaping or buffing. It is a type of machining using a wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the metal through shear deformation. Bench grinder used in the proposed project is shown in Figure 17.

Figure 17: Bench Grinder

Different sizes of grinding wheels are shown in Figure 18.

Figure 18: Different Sizes of Grinding Wheels

Bench Drilling Machine

Bench drilling machine is used to drill or enlarge holes with a boring tool or to finish holes with a reamer. A reamer is a type of rotary cutting tool used in metal working. Reamers are designed to enlarge the size of a previously formed hole but with a high degree of accuracy to leave smooth sides Bench Drilling machine used in proposed project is shown in Figure 19.

Figure 19: Drilling Machine

Lathe Machine

A lathe machine is a machine tool that is used to remove metals from a work piece to give it a desired shape and size. Lathe Machines are used in metal working or metal spinning or other machining operations. The most common lathe operations are turning, facing, grooving, parting, threading, drilling, boring, knurling and tapping.

Figure 20 shows a lathe machine. The movements of a traditional lathe machine are manually controlled by an operator. Figure 20 shows lathe machine.

Figure 20: Lathe Machine

Testing Tools

Ampere Meter

Ampere meter, also known as ammeter, is a measuring instrument used to find the strength of current flowing around an electrical circuit when connected in series with the part of the circuit being measured. Figure 21 shows an ampere meter.

Figure 21: Ampere Meter

Ohm Meter

Ohmmeter is an instrument used to measure electrical resistance (expressed in ohms). In the simplest ohmmeters, the resistance to be measured may be connected to the instrument in parallel or in series. If in parallel (parallel ohmmeter), the instrument will draw more current as resistance increases.

Figure 22: Ohm Meter

Volt Meter

Voltmeter is used to check the input voltages of motors. It is connected in parallel to the circuit for which voltage is to be measured. Figure 23 shows volt meter.

Figure 23: Volt Meter

Manual Chain Hoist

Manual chain hoists (also known as chain blocks) are used to lifting applications of heavy loads by using a chain that is hand-operated. Manual chain block hoists contain a chain that is wound around two wheels. Manual chain hoists are ideal for use in industrial production lines and small machine shops where lifting is required. The Manual chain hoist used in the proposed project is used to lift heavy electric motors and other heavy objects up to 500 kg. Figure 24 shows Manual chain hoist.

Figure 24: Manual Chain Hoist

Weighing Scale

Weighing scale is used to measure the quantities of raw materials. A weighing scale used in the proposed project is shown in Figure 25.

Figure 25: Weighing Scale

Manual Coil Winding Machine

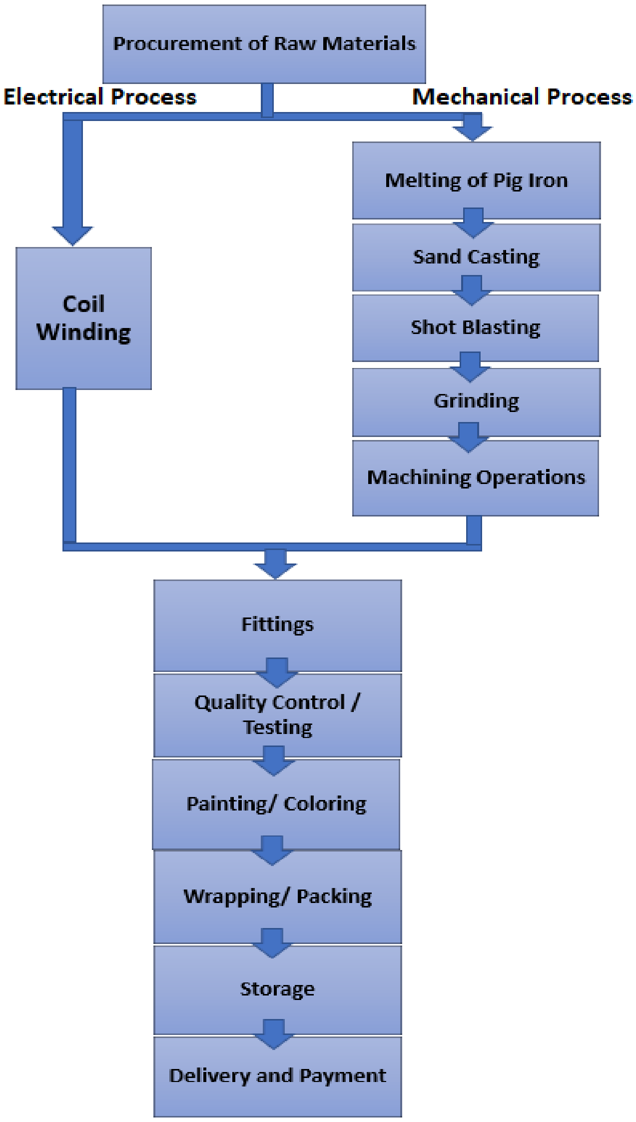
Electrical coil winding machine is used to wind coils for motors, transformers, inductors and chokes. Coil winding equipment is used in a variety of wire winding, wire welding, and wire bonding applications. Manual Coil Winding machine is shown in Figure 26.

Figure 26: Manual Coil Winding Machine

5.2 Process Flow

Process flow for manufacturing electric motors is shown in Figure 27.

Figure 27: Process Flow for Manufacturing Electric Motors (AC)



<u>Procurement of Raw Materials</u>

The proposed project manufactures AC electric motors (single phase induction motors and synchronous motors), using pig iron as the main raw material which is procured in the form of pig iron ingots. Pig Iron is of three main types i.e., basic pig iron, foundry pig iron and nodular pig iron. The pig iron is wear-resistant, hard and also brittle and mildly fusible. Pig iron is produced by smelting iron ore in blast furnaces. Pig iron is supplied in a variety of ingot sizes and weights, ranging from 3 kg up to more than 50 kg. The pig iron, used for manufacturing of electric motors, is specified as basic pig iron (also known as hematite pig iron). Pig iron is not available locally and is imported from different countries such as Brazil, Russia, Ukraine and China.

Other components for making electric motors include fan, copper wire, V-rings, Rotor with Shaft, Name plate, polythene sheet, Paint, washers, nuts and bolts are also procured. These components are readily available in metropolitan cities such as Karachi, Lahore, Gujranwala, Gujrat, Peshawar and Faisalabad. Figure 28 shows pig iron ingots.

Figure 28: Basic Pig Iron Ingots

Mechanical Processes

Mechanical processes consists of melting of pig iron, sand casting, shot blasting, grinding and machining operations. Explanation of these operations is as follows:

Melting

Melting of the metal includes the following steps:

- ***Preparing the Metal***

Before loading into the furnace, pig iron ingots are cleaned of any dirt to avoid/minimize injuries arising from molten metal splash. The metal is also dried to remove any moisture.

- **Loading and Melting Pig Iron**

Metal/pig iron is continuously loaded by labor into the furnace as a continuous process instead of melting in batches. This saves energy consumption and improves work effectiveness. The furnace runs in an extremely hard environment where molten metal, furnace linings, atmospheric gases and products from combustion of fuels exist at very high temperatures. This requires mandatory use of protection equipment by the worker. The loaded metal melts at around 1000 degree Celsius. The operation of the furnace is controlled by its control panel. After melting, the molten liquid is transported from the furnace to the molding line with the help of furnace ladle. Figure 29 shows ladle and Figure 30 shows Furnace.

Figure 29: Ladle

Figure 30: Furnace

Sand Casting

Sand casting, also known as sand molding casting, is a casting-based manufacturing process that involves the use of a sand mold. Crystalline silica has a higher melting point (1610 C) than iron and other common metals. This enables castings to be made by pouring molten metal into molds made from silica sand and a binder.[7]

[7] A mixture of clay and water is the most commonly used binder for casting purpose.

It is used to create metal products and components in a variety of sizes and shapes. In sand casting, a mold pattern of the desired finished part (i.e., motor body frame and end-shields) are used. These mold patterns are procured locally. Sand is filled around the pattern with the help of shovels and spades. The sand is then compacted or compressed to make it hard and of uniform level with the help of rammer, mallet and smoothers. Runners and risers are made with the help of sprue pins and the pattern is then removed from the bonded sand, leaving a cavity in the mold in the shape of the part. Molten metal/liquid is poured into the cavity through furnace ladle. After the molten metal has been poured into the mold cavity, it is left for some time to cool it. As the molten metal cools, it changes from liquid to solid state. The sand is then removed through a shakeout process. The pattern can be reused in the next castings.

Figure 31 shows a product being sand casted using a pattern and Figure 32 shows a sand casted Motor body.

Figure 31: Sand Casting Process

Figure 32: Sand Casted Motor Body

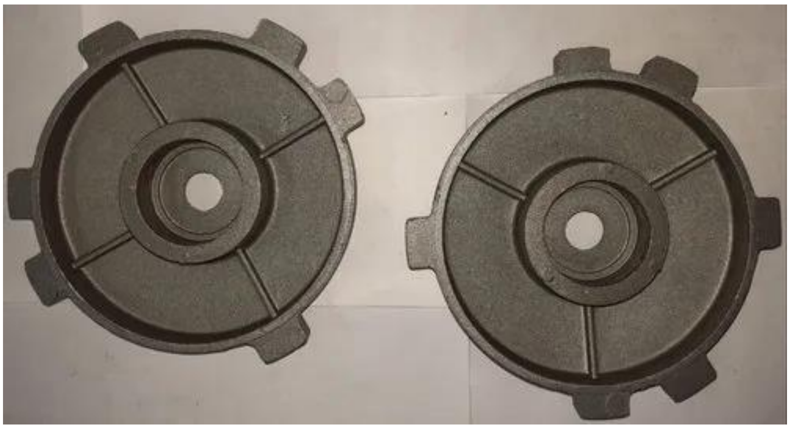
In the proposed unit, the electric motor bodies and end-shields of motors are sand casted and the whole process is carried out manually by labor. Bodies of motors and end-shields are casted as single piece wherein other components are then fixed.

Shot Blasting

The shot blasting process uses a centrifugal blast wheel that shoots media onto a surface at high velocity. This knocks the surface free of debris[8] and other materials. The shot media, which varies from steel shot to cut wire to nut shells, loads into a hopper that feeds the blast wheel. The media used in the proposed project is steel shots which are shot at high speed (65-110 meter per second) in a controlled manner at the motor frame, thereby removing surface contaminations due to the abrasive impact. Figure 33 shows a motor frame before and after shot blasting process and Figure 34 shows end-shields of a motor after shot blasting.

Figure 33: Motor Frame before and after Shot Blasting

Figure 34: End-Shields of a Motor after Shot Blasting



[8] loose natural material consisting especially of broken pieces of metal

Grinding

Grinding is a machining process that uses a grinding wheel or grinder as the cutting tool. Grinding is a subset of cutting, as grinding is a proper metal-cutting process. Grinding is used to finish motor frame that must show high surface quality and high accuracy of shape and dimensions. It has some roughing applications in which grinding removes high volumes of metal very rapidly. Sometimes there is need to cut the additional metal from parts for the fitting purposes and purpose of grinding is also finishing of metals (motor frame and end shields etc.). A bench grinder is used for grinding of motor frame. Figure 35 shows a component in the process of grinding.

Figure 35: Grinding

Machining Operations

Machining is a process that produces parts of desired sizes and shapes by removing material in the form of small chips from a solid work piece using a single or multiple-edged cutting tools. It is often used to improve the tolerances or surface finish of parts made through sand casting by accurately removing small amounts of material from selected portions of the surface. Two major machining operations are done in motor manufacturing:

- Lathe Operations
- Drilling Operations

Lathe machines are used primarily to produce cylindrical or conical exterior and interior surfaces of casted body/frame of motor via turning, facing, boring and drilling. In a lathe machine, the motor body/frame is rotated while the cutting tool is moved into the motor body/frame in a direction parallel and/or perpendicular to the axis of rotation of the body. Drilling machine is used to drill holes in the motor body and end-shields according to the required design for fixing pins and nuts and bolts. Machining process is shown in Figure 36.

Figure 36: Machining Operations

Electrical Process

Electrical process consists of winding operation which is described as follows:

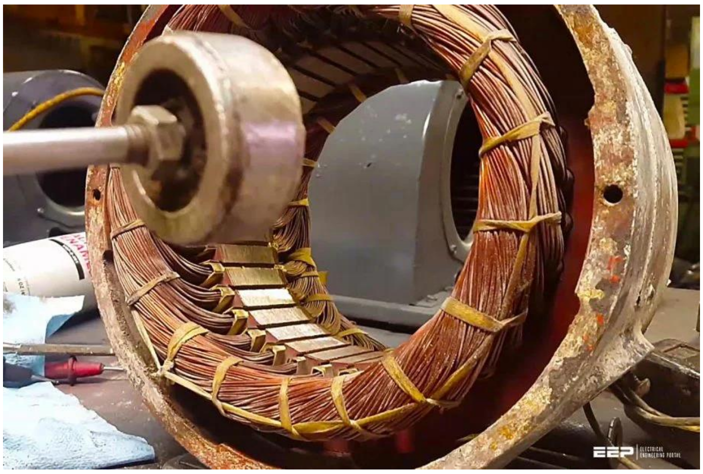
Winding

Motor windings are conductive wires wrapped around a stator core/slot. Motor winding provides a path for current to flow to create magnetic field to spin the rotor. Like any other part of the motor, the winding can fail. The number of slots depends on how many phases of power are provided to the coil windings. A simple AC single-phase induction motor typically has four slots containing two pairs of coil windings. In contrast, a three-phase motor typically features six slots containing three pairs of coil windings. Copper is the most common material used for motor winding construction. This is primarily due to its high electrical conductivity. After wrapping of windings around a magnetic core, thread is used to fix and tight the winding with magnetic core/stator.

Winding is made by a manual coil winding machine, operated by a worker. Figure 37 shows winding process on manual winding machine and Figure 38 shows winding on magnetic core/stator.

Figure 37: Winding on Manual Winding Machine

Figure 38: Winding on Stator

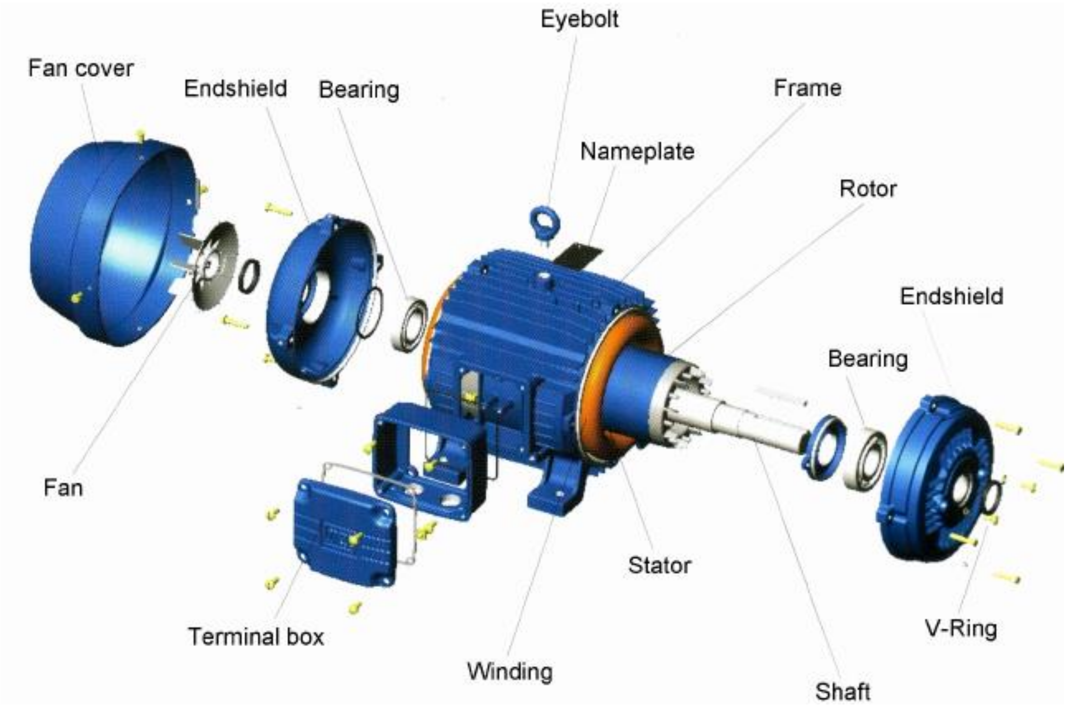


After completion electrical and mechanical operations, the next process step is fitting/assembling of electric motor parts.

Fitting/Assembling

Electric motor assembly is the last stage in the manufacturing process. Motor assembly is the process of combining all parts and components of the motor together to make it a product according to the specified type of the motor. In the proposed project, assembling is done manually by labor. The parts to be assembled include fan cover, fan, end-shields, bearings, eyebolt, name plate, rotor with shaft, frame/body, v-ring, stator, winding, terminal box operating wheel, spindle and O-rings. Figure 39 shows all components of electric motor.

Figure 39: Components of Electric Motor



Explanation of all components is as follows:

Fan Cover

Electric motor fan covers provide the needed protection against, other environmental factors and also provide safety against injuries. Motor fan covers extend motor life and reduce downtime and labor costs for improved productivity.

Fan

The purpose of attaching fan to electric motor is to cool the motor. Motor fan is attached to the rotor of the motor (usually on the opposite end as the output shaft) that spins with the motor and provides increased airflow to the motor's internal and external parts which aids in cooling.

End-Shields

End-shield is a part of the motor which supports the bearing and acts as a protective guard to the winding and rotating parts inside the motor. Two end-shields are used in one motor.

Terminal Box

Electric motor has terminal box which house the connections between lead wires from the motor and feed wires from a source of electricity.

Winding

The motor winding refers to the type of winding of the electrical conductor for generating a magnetic field used to drive the rotors in an electric. The design determines the available torque, the electromagnetic force in the system, the electrical resistance, and therefore the application. Copper wire is a common material used for winding.

Stator

The stator is the stationary component of electromagnetic circuits in motors and is made up of thin metal sheets, called laminations.[9] In different configurations, stators may act as field magnets that interact with the rotor to create motion, or as armatures[10] that work with moving field coils on the rotor. The winding is fixed in stator.

V-Ring

V-rings serve as lip seals or flinger rings. They are used to seal against dust, dirt, grease, oil and water splashes from the outside. The V-ring rotates with the shaft while sealing axially against the counter surface.

Bearings

Bearings, in electric motors, are designed to support the rotor and maintain a consistent air gap between the rotor and the stator as well as transferring the loads

[9] Laminations are used to reduce energy losses that would result if a solid core was used.
[10] The armature is the winding of an electric machine which carries alternating current.

from the shaft to the motor frame. The bearings should be able to operate at low and high speeds, while minimizing frictional loses. Two bearings are used in one motor.

Eyebolt

Eyebolts can be used as a connection point for rigging, anchoring, pulling, pushing or hoisting applications. Eyebolts are commonly used in industrial applications.

Nameplate

A nameplate contains useful information relating to the motor including the type, RPM. frame size and power of the motor.

Motor Frame/Body

This is the supporting structure of the motor assembly. The frame can be manufactured from a variety of materials which include iron, steel or die-cast aluminum. This is the container in which field with winding and rotor with shaft are contained.

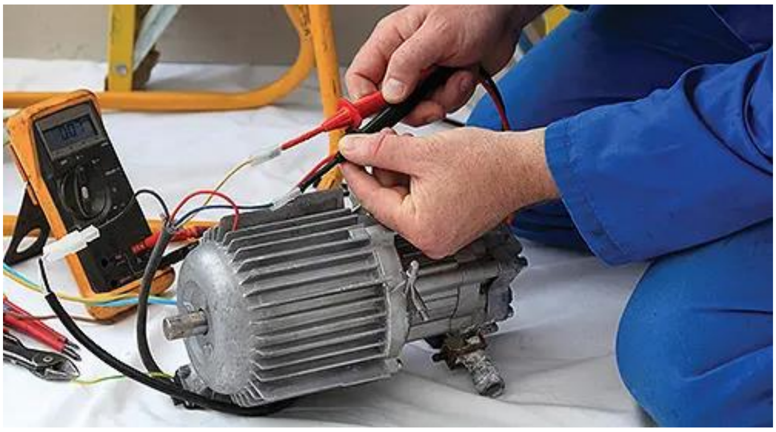
Rotor with Shaft

Rotor is the moving part in an Alternator that has permanent magnets that move around the Stator's iron plates to generate an alternating current. Rotor works through magnetic field produced by stator and moves due to magnetic field. Shaft is part of the rotor. The shaft takes the rotational energy from the rotor’s spinning and provides a mean to harness that energy via a mechanical connection. The purpose of the shaft is to convert energy from the motor into the end use application.

Quality Control/Testing

Each assembled electric motor is checked manually by an experienced person. The current is measured by ampere meter and resistance is checked by Ohm-meter. Voltages given to a motor are checked by volt meter. Figure 40 shows testing of a motor. The resistance of a motor should be between 0.3 to 2 ohms. If it is 0, there is a short circuit. If it is over 2 ohms or infinite, there is an open circuit. Figure 40 shows testing process of an electric motor.

Figure 40: Testing of an Electric Motor



Painting

The motors passing the quality tests are painted to finish the products, using an electric-paint sprayer. Paint helps in enhancing the useful life of electric motors by protecting these from corrosion and improves its aesthetic appearance. Figure 41 shows a painted electric motor.

Figure 41: Painted Electric Motor

Wrapping

Once the paint dries, the electric motors are wrapped with polythene sheet manually. Each motor is packed separately. A wrapped finished product after (electric motor) is shown in Figure 42.

Figure 42: Wrapped Finished Product (Electric Motor)

Storage

The finished products (electric motors) are stored and are ready to be dispatched.

Delivery and Payment

After packaging, the product is delivered to the customer. According to the market norms, a credit facility of 15 days is usually allowed to the customers. The products are transported to the customer premises either by the manufacturers or by the customers themselves. The customer pays the transportation cost of delivering the products to the customer premises.

5.3 Installed and Operational Capacities

Based on 300 working days in a year and a single shift of 8 hours per day, the total installed capacity of the proposed manufacturing unit is 33,600 motors (including 16,800 1HP induction motors, 7,200 2HP induction motors, 7,200 1HP synchronous motors and 2,400 2HP synchronous motors). However, during the 1st year of operations, the unit is expected to achieve 50% of its total installed capacity which translates into manufacturing 16,800 motors (including 8,400 1HP induction motors, 3,600 2HP induction motors, 3,600 1HP synchronous motors and 1,200 2HP synchronous motors). The total capacity of the proposed unit is determined by the melting capacity of furnace i.e. 120 kg per hour. Table 3 shows the melting capacity of the furnace and Table 4 shows the installed and operational capacities.

Table 3: Furnace Melting Capacity

Basis	No of Furnaces	Melting Capacity / Hour (Kgs)	Annual Melting Capacity (Kgs)
Furnace	1	120	288,000

Table 4: Installed and Operational Capacity

Particulars	Furnace Capacity / Hour (Kgs)	Gross Pig Iron Consumption /Unit (KG)	Production Ratio	Production/ Hour (Units)	Production/ Day @ 100% Capacity (Units)	Production/ Annum @ 100% Capacity (Units)	Production/ Annum @ 50% Capacity (Units)
Induction Motor							
1HP		7.14	42%	7	56	16,800	8,400
2HP		8.67	28%	3	24	7,200	3,600
Synchronous Motor	120						
1HP		7.14	18%	3	24	7,200	3,600
2HP		8.67	12%	1	8	2,400	1,200
Total (PKR)			**100%**			**33,600**	**16,800**

6. CRITICAL FACTORS

Following factors should be considered while making the investment decision:

- Good technical knowhow and basic knowledge of the process
- Strong knowledge of the market requirements
- Production of quality products, specific to users' needs
- Availability of high-quality raw material at economical cost
- Availability of skilled workforce
- Rigorous supervision of the process at every level
- Close supervision of the production processes
- Ability to generate work orders through industrial networking (B2B and B2C)
- Assurance of timely order fulfillment

7. GEOGRAPHICAL POTENTIAL FOR INVESTMENT

The demand for setting up the manufacturing unit for electric motors is higher in large cities as majority of industries are located in the big cities of Pakistan. Therefore, the geographical potential for investment in this business is higher in larger cities like Karachi, Lahore, Islamabad, Peshawar, Rawalpindi, Quetta, Faisalabad, Sialkot, Hyderabad, Gujranwala, Multan, Sukkur or any other major city.

Availability of skilled labor is vital while selecting a location. The above-mentioned cities have good availability of skilled labor, raw materials and have presence of large numbers of industrial units. The proposed production unit for electric motors is proposed to be established in these cities.

8. POTENTIAL TARGET CUSTOMERS / MARKETS

AC motors are used as a power source for many applications, such as pumps, food and beverage machines, automated conveyer equipment, packaging operations, washing machines, electric knife sharpeners, office equipment, ovens, water heaters etc.

Manufacturers sell motors directly to industries. Other than the above-mentioned industries, distributors and wholesalers are also the potential customers. Wholesalers and distributors purchase motors from the manufacturing units directly and then sell those to local retail and commercial markets, to be further sold to the customers.

The "Global electric motor market" report, a recent research by Allied Market Research, reveals that the global electric motor market size was $96,967.9 million in 2017, which is projected to reach $136,496.1 million in 2025, growing at a CAGR of 4.5%.

The rise in demand for superior machine control in automotive industry, owing to the high efficiency of AC synchronous motors fuels the electric motor market growth.

The regulations such as Minimum Energy Performance Standards (MEPS), drives the growth of energy efficient electric motors market across the world.[11]

According to the Observatory of Economic Complexity (OEC),[12] in 2020, Pakistan imported electric motors worth $117 million under the HS code 8501, becoming the 51st largest importer of electric motors in the world. During the same year, electric motors were the 79th most imported product in Pakistan. Pakistan imports Electric Motors primarily from China ($72.1M), United States ($12.7M), Germany ($4.9M), United Arab Emirates ($3.53M) and Australia ($3.22M).

During the same year, Pakistan exported $3.35 million in electric motors, making it the 72nd largest exporter of electric motors in the world. In the same year, electric motors were the 297th most exported product of Pakistan. The main destination of electric motors exports from Pakistan were United States ($2.11M), Argentina ($267K), Finland ($260K), Germany ($132K), and United Arab Emirates ($79.7K).

According to UN Comtrade Database,[13] In 2021, Pakistan imported $202 million worth of electric motors. Pakistan's exports for 2021 also increased to $4.18 million under HS code 8501.

The net trade during 2020 and 2021 was negative as imports were more than exports to cater to the local demand. The data shows that there are good opportunities for the prospective investors in electric motor business.

The electric motor market is segmented on the basis of motor type, output power and application. On the basis of motor type, the market is divided into AC (Alternative Current) motor and DC (Direct Current) motor. Depending upon power, the market is divided into integral horsepower (IHP) output and fractional horsepower (FHP) output.[14] By application, the market is segregated into automotive, HVAC, medical equipment, industrial machinery and home appliances etc.

AC motors are used as a source of power in number of industries such as water pump manufacturing industry, food and beverage machines manufacturing industries, conveyer equipment manufacturing industries, washing machines manufacturing industries and household equipment manufacturing industries. Emerson Electric Co, DENSO Corporation, Nidec Corporation and Siemens AG are the major global key players in electric motors manufacturing industry.

Electric motor manufacturers are present in Gujranwala, Lahore, Faisalabad, Gujrat, Karachi, Peshawar, Multan and Quetta but Gujranwala, Lahore and Karachi are the

[11] https://www.electricmotorengineering.com/a-global-electric-motor-market-overview/
[12]https://oec.world/en/profile/bilateral-product/electric-motors/reporter/pak
[13] https://comtrade.un.org/
[14] An integral horsepower gearmotor is any motor with a horsepower of 1 and above, as opposed to fractional horsepower motors that are less than 1 hp. The design considerations for integral horsepower motors are going to be fairly similar to fractional horsepower motors because the same types of parameters are important.

biggest electric motor clusters in Pakistan. The major manufacturing brands for electric motors in Pakistan are HECO Motors Pvt. Ltd, AECO Electric Company by Azeem Brothers, GRC Electric Motors, GMG Electric Motors, SunRise Water Pumps & Electrical Motors and Eagle Electric Motors etc.

Most of the small scale manufacturers do not manufacture new motors. Instead, they repair used or damaged motors and sell them for reuse.

9. PROJECT COST SUMMARY

A detailed financial model has been developed to analyze the commercial viability of Manufacturing Unit for Electric Motors. Various costs and revenue related assumptions, along with results of the analysis are outlined in this section.

The projected Income Statement, Balance Sheet and Cash Flow Statement are attached as Annexure.

Project is proposed to be financed through 100% equity. Total project cost has been estimated to be PKR 22,546,872 which comprises of capital investment of PKR 16,002,375 and working capital of PKR 6,544,498.

9.1 Initial Project Cost

The details of initial project cost calculated for the manufacturing unit are shown in Table 5.

Table 5 Initial Project Cost Estimates

Particulars	Cost (PKR)	
Land	-	
Building Rennovation / Infrastructure	1,831,836	9.1.2
Machinery & Equipment	7,826,000	9.1.3
Tools & Material Handling Equipment	443,300	9.1.4
Furniture & Fixtures	1,575,000	9.1.5
Office Vehicles	566,000	9.1.6
Office Equipment	2,091,000	9.1.7
Security against Building	1,012,500	9.1.8
Pre-operating costs	656,739	9.1.9
Total Capital Cost – (A)	**16,002,375**	
Working Capital		
Spares inventory	65,217	
Raw material inventory	4,756,365	

Consumables inventory	52,246	
Upfront insurance payment	170,670	
Cash	1,500,000	
Total Working Capital - (B)	**6,544,498**	
Total Project Cost - (A+B)	**22,546,872**	

9.1.1 Land

The proposed manufacturing unit for electric motors will be established in a rented building. Suitable location for setting up of manufacturing unit like this can be easily found in the industrial areas of cities mentioned above. Therefore, no land cost has been added to the project cost. Total space requirement for the proposed project has been estimated as 6,750 sq. feet. Breakup of the space requirement is provided in Table 6.

Table 6: Breakup of Space Requirement

Break-up of Area	% Break-up	Area (Sq. ft.)
Executive Office	2%	150
Admin and Accounts Department	2%	150
Sales and marketing Department	4%	300
Procurement Office	2%	150
Raw material Store	11%	750
Melting and Casting Area	33%	2,200
Shot blasting and Machines Working Area	10%	700
Winding Area	2%	150
Fitting/Assembling Area	7%	500
Testing and Quality Control Area	2%	150
Painting/Coloring and Wrapping Area	4%	240
Finished Goods Store	11%	750
Parking and Gate area	6%	400
Washroom	2%	160
Total Area	**100%**	**6,750**

9.1.2 Building and Renovation Cost

There will be no cost of building construction since the manufacturing unit will be started in rented premises. However, there will be a renovation cost required to make the building usable for the business. The proposed unit requires estimated electricity load of 16 KW for which an electricity connection under the Industrial Tariff will be required. Table 7 provides details of building renovation cost.

Table 7 Renovation Cost Details

Cost Item	Unit of Measurement	Total Units	Cost per Unit (PKR)	Total Cost (PKR)
Paint Cost	Liter	162	800	129,856
Labour Cost – Paint	Sq. Feet	16,232	15	243,480
Wall Racks – Production and Store Room	No.	50	15,000	750,000
Wall Racks – Office	No.	10	10,000	100,000
Curtains	No.	6	6,000	36,000
Blinds	No.	4	7,000	28,000
Glass Partition and Doors	Sq. Feet	990	550	544,500
Total				**1,831,836**

9.1.3 Machinery and Equipment Requirement

Table 8 provides details of office equipment required for the proposed project.

Table 8: Machinery and Equipment Requirement

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Gas Furnace (120 KG/Hr)	1	2,000,000	2,000,000
Grinding Machine/Bench Grinder	2	70,000	140,000
Shot Blasting Machine (120 KG/Hr)	2	700,000	1,400,000
Lathe Machine (Spindle Speed 45-1800 r /min, max swing 410mm, spindle bore 52mm, 8kw)	2	1,500,000	3,000,000
Drilling Machine(Dia. 12.7mm)	2	600,000	1,200,000
Manual Pallet Jack	2	15,000	30,000
Manual Chain Hoist	1	30,000	30,000
Weighing Scale	2	5,000	10,000

Coil Winding Machine	2	8,000	16,000
Total Cost (PKR)			**7,826,000**

9.1.4 Hand Tools & Material Handling Equipment

Table 9 shows details of tools and material handling equipment required for the proposed project.

Table 9: Hand Tools & Material Handling Equipment

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Hand Rammer (Head weight 10 kg)	4	10,000	40,000
Electrical Tool Kit			
Wire strippers	2	800	1,600
Insulated screwdrivers	2	750	1,500
Insulated pliers	2	2,200	4,400
Hacksaws	2	4,000	8,000
Cable cutters	2	560	1,120
Spanners	2	200	400
Safety knife	4	200	800
Claw Hammer	8	900	7,200
Tape Measure	4	350	1,400
Testing Tools			
Ampere Meter	2	1,500	3,000
Ohm-Meter	2	1,500	3,000
Volt Merere	2	1,500	3,000
Mechanical Tool Kit			
Casting Tray/Flask	100	500	50,000
Metal Patterns	100	1,300	130,000
Screwdrivers	5	2,000	10,000
Pry Bar	2	5,000	10,000
Wrenches	5	2,100	10,500
Pliers	1	4,200	4,200
Ratchet and Socket Sets	2	2,890	5,780
Allen Wrenches	5	720	3,600

Scissors	20	160	3,200
Mechanical gloves	1	5,000	5,000
Drill	1	8,000	8,000
Electric Paint Sprayer	8	9,000	72,000
Wheel Barrow	4	2,800	11,200
Mallet	6	2,000	12,000
Vernier Calipers	4	1,800	7,200
Strike off bar	2	1,300	2,600
Gate Cutter	4	800	3,200
Shovels	4	500	2,000
Trowels	8	300	2,400
Sprue Pin	100	500	50,000
Total			**443,300**

9.1.5 Furniture and Fixture

Table 10 provides details of furniture and fixtures.

Table 10: Furniture & Fixtures Cost Details

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Executive Tables	1	75,000	75,000
Executive Chairs	1	35,000	35,000
Office Table	8	35,000	280,000
Office Chairs	30	16,000	480,000
Sofa Set	3	55,000	165,000
Racks	60	9,000	540,000
Total			**1,575,000**

9.1.6 Vehicle Requirement

Table 11 provides details of the vehicles required along with their cost for the proposed project.

Table 11: Office Vehicle Cost Details

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Loader - Rickshaw (150 cc)	1	400,000	400,000
Motorcycle	1	145,000	145,000
Registration Charges-Loader		14,000	14,000
Registration Charges-Motorcycle		7,000	7,000
Total Cost (PKR)			**566,000**

9.1.7 Office Equipment

Table 12 provides details of the office equipment requirement of the project.

Table 12: Office Equipment Requirement

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Laptop(s)	4	150,000	600,000
Desktop Computers	4	50,000	200,000
Inkjet Printer	2	48,000	96,000
CCTV Cameras (2MP)	16	3,500	56,000
DVR	2	18,000	36,000
LED TV (32")	1	45,000	45,000
Inverter Air Conditioners (1.5 Ton)	4	160,000	640,000
Exhaust Fan	20	5,000	100,000
Bracket Fan	5	12,000	60,000
Ceiling Fan	12	9,000	108,000
Pedastal Fan	3	12,000	36,000
Water Dispenser	2	34,000	68,000
Wi-Fi / Internet Router	1	4,000	4,000
LED Bulbs	140	300	42,000
Total Cost (PKR)			**2,091,000**

9.1.8 Security against Building Rent

Details of security against building rent for the project are provided in Table 13.

Table 13: Security against Building Rent

Cost Item	Months	Unit Cost/Month (PKR)	Total Cost (PKR)
Security against Building Rent	3	337,500	**1,012,500**

9.1.9 Pre-Operating Costs

Table 14 provides details of estimated pre-operating costs.

Table 14 Pre-Operating Cost Details

Costs Item	Hiring Months Before in Year 0	Cost (PKR)
Administrative Expenses	1	440,000
Utilities Expense		216,739
Total Cost (PKR)		**656,739**

9.2 Breakeven Analysis

Table 15 shows calculation of breakeven analysis.

Table 15: Breakeven Analysis

Description	First Year Values (PKR)	Ratios
Sales (PKR)	158,460,000	100%
Variable Cost (PKR)	133,796,018	84%
Contribution (PKR)	24,663,982	16%
Fixed Cost (PKR)	14,758,190	11%
Contribution Margin		16%
Breakeven		
Breakeven Revenue (PKR)		94,817,732
Breakeven Units (Units)		10,053
Breakeven Capacity		30%

9.3 Revenue Generation

Table 16 provides details for revenue generation of the manufacturing unit during the first year of operations.

Table 16: Revenue Details

Product	Units Sold[15]	Sale Price per Unit (PKR)	Revenue (PKR)
Induction Motor			
1HP	7,980	7,500	59,850,000
2HP	3,420	15,000	51,300,000
Synchronous Motor			
1HP	3,420	8,500	29,070,000
2HP	1,140	16,000	18,240,000
Total (PKR)			**158,460,000**

9.4 Variable Cost Estimate

Variable costs of the project have been provided in Table 17.

Table 17 Variable Cost Estimate

Description of Costs	Amount (PKR)
Induction Motor	80,541,000
Synchronous Motor	33,611,760
Direct Electricity	1,917,002
Gas Cost	324,291
Direct Labour	12,720,000
Consumables	626,950
Machinery Repair and Maintenance	782,600
Indirect Electricity	683,865
Office vehicles running and maintenance expense	367,950
Office expenses (stationery, entertainment, janitorial services etc.)	636,000
Bad debt expense	1,584,600
Total	**133,796,018**

[15] Half month production is maintained as finished good inventory.

Table 18 Raw Material – Copper Consumption

Particulars	Copper Wire Consumption/Unit (Kg)	Cost / Kg	Cost of Copper Wire/Motor
Induction Motor			
1HP	0.75	1,200	900
2HP	1.50		1,800
Synchronous Motor			
1HP	0.75		900
2HP	1.50		1,800

Table 19: Iron Cost per Unit

Particulars	Weight for Motor Body and End-Sheild (Kgs)	Process Loss	Gross Pig Iron Consumption/Unit (KG)	Pig Iron Price Per KG (PKR)	Total Cost/ Unit (PKR)
Induction Motor		2%		180	
1HP	7.0		7.14		1285.20
2HP	8.5		8.67		1560.60
Synchronous Motor					
1HP	7.0		7.14		1285.20
2HP	8.5		8.67		1560.60

Table 20: Other Components Cost-Induction Motor

Cost Item	No		Cost/Unit (PKR)		Cost/Motor (PKR)	
	1 HP (A)	2HP (B)	1 HP (C)	2HP (D)	1 HP (E=A*C)	2HP (F=B*D)
Fan	1	1	30	35	30	35
Fan Cover	1	1	40	40	40	40
Bearings	2	2	300	300	600	600
Name Plate	1	1	20	20	20	20
Rotor	1	1	1,000	1,500	1,000	1,500
V-Rings	2	2	5	5	10	10

Stator	1	2	1,000	2,000	1,000	4,000
Terminal Box	1	1	15	15	15	15
Capacitor	1	1	300	400	300	400
Other Cost (Paint, Sleeves, Thread, Hitech Paper, Packing, etc.)					400	500
Total					**3,415**	**7,120**

Table 21: Other Components Cost- Synchronous Motor

Cost Item	No		Cost/Unit (PKR)		Cost/Motor (PKR)	
	1 HP (A)	**2HP (B)**	**1 HP (C)**	**2HP (D)**	**1 HP (E=A*C)**	**2HP (F=B*D)**
Fan	1	1	30	35	30	35
Fan Cover	1	1	40	40	40	40
Bearings	2	2	300	300	600	600
Name Plate	1	1	20	20	20	20
Rotor	1	1	1,500	2,200	1,500	2,200
V-Rings	2	2	5	5	10	10
Stator	1	2	1,000	2,000	1,000	4,000
Terminal Box	1	1	15	15	15	15
Capacitor	1	1	300	400	300	400
Other Cost (Paint, Sleeves, Thread, Hitech Paper, Packing etc.)					400	500
Total					**3,915**	**7,820**

Table 22: Total Material Cost

Cost item	Copper Winding Cost (PKR)	Iron Consumption (PKR)	Other Cost Component (PKR)	Total Cost (PKR)
Induction Motor				
1 HP	900	1,285	3,415	5,601
2 HP	1,800	1,561	7,120	10,481
Synchronous Motor				
1 HP	900	1,285	3,915	6,101
2 HP	1,800	1,561	7,820	11,181

Table 23: Consumables

Cost Item	Unit of Measurement	Annual Consumption (Units)	Unit Cost (PKR)	Total Cost (PKR)
Grinder Wheels	No.	130	1,200	156,000
Cutting wheels	No.	120	1,000	120,000
Steel Shots (For Shot Blasting)	KG	20	420	8,400
Drill Bits	Sets	40	2,500	100,000
Smoother	No.	15	850	12,750
Lubrication Oil	Liters	20	350	7,000
Safety Gloves	No.	40	220	8,800
Safety Helmets	No.	20	700	14,000
Green Sand	KG	1000	200	200,000
Total Cost				**626,950**

Table 24: Direct Labor

Personnel	Number of Personnel	Salary Per Month Per-Person (PKR)	Annual Salaries (PKR)
Production Manager	1	120,000	1,440,000
Production Supervisors	1	70,000	840,000
Skilled Workers - Casting and Furnace	3	40,000	1,440,000
Unskilled Workers - Casting and Furnace	5	30,000	1,800,000
Operator - Lathe Machine	2	45,000	1,080,000
Operator - Drill Machine	1	35,000	420,000
Operator - Grinding Machine	1	35,000	420,000
Operator - Winding Machine	2	35,000	840,000
Assembly Labor-1 HP Induction Motor	2	30,000	720,000
Assembly Labor-2 HP Induction Motor	1	30,000	360,000
Assembly Labor-1 HP Synchronous Motor	2	30,000	720,000
Assembly Labor-2 HP Synchronous Motor	1	30,000	360,000
Electrical Technician	1	35,000	420,000
Painters	2	30,000	720,000
Worker – Packing	1	25,000	300,000
Quality Controller	1	70,000	840,000
Total	**27**		**12,720,000**

Table 25 Machinery Maintenance Cost

Cost Item	Machinery Cost (PKR)	Rate	Total Cost (PKR)
Machinery Maintenance Cost	7,826,000	10%	**782,600**

9.5 Fixed Cost Estimate

Table 26 shows the estimated fixed cost of the project.

Table 26: Fixed Cost Estimate

Description of Costs	Amount (PKR)
Administration expense	6,360,000
Administration benefits expense	636,000
Building rental expense	4,050,000
Communications expense (phone, internet etc.)	636,000
Professional fees (legal, audit, consultants, etc.)	636,000
Insurance expense	170,670
Depreciation expense	2,138,173
Amortization of pre-operating costs	131,348
Total	**14,758,191**

9.6 Financial Feasibility Analysis

The financial feasibility analysis provides the information regarding projected Internal Rate of Return (IRR), Net Present Value (NPV) and Payback period of the study, which is shown in Table 27.

Table 27: Financial Feasibility Analysis

Description	Project
IRR	63%
NPV (PKR)	70,675,335
Payback Period (years)	2.51
Projection Years	10
Discount rate used for NPV	25%

9.7 Financial Feasibility Analysis with 50% Debt

The financial feasibility analysis provides the information regarding projected IRR, NPV and payback period of the study on the basis of Debt: Equity Model (50:50), which is shown in Table 28.

Table 28: Financial Feasibility Analysis with 50% Debt

Description	Project
IRR	61%
NPV (PKR)	84,887,374

Payback Period (years)	2.61
Projection Years	10
Discount rate used for NPV	22%

9.8 Human Resource Requirement

The proposed project shall require the workforce as provided in Table 29.

Table 29: Human Resource

Personnel	Number of Persons	Salary Per Month Per-Resource (PKR)	Annual Salaries (PKR)
Production Manager	1	120,000	1,440,000
Production Supervisors	1	70,000	840,000
Skilled Workers - Casting and Furnace	3	40,000	1,440,000
Unskilled Workers - Casting and Furnace	5	30,000	1,800,000
Operator - Lathe Machine	2	45,000	1,080,000
Operator - Drill Machine	1	35,000	420,000
Operator - Grinding Machine	1	35,000	420,000
Operator - Winding Machine	2	35,000	840,000
Assembly Labor-1 HP Induction Motor	2	30,000	720,000
Assembly Labor-2 HP Induction Motor	1	30,000	360,000
Assembly Labor-1 HP Synchronous Motor	2	30,000	720,000
Assembly Labor-2 HP Synchronous Motor	1	30,000	360,000
Electrical Technician	1	35,000	420,000
Painters	2	30,000	720,000
Worker - Packing	1	25,000	300,000
Quality Controller	1	70,000	840,000
Sales and Marketing Manager	1	80,000	960,000
Sales and Marketing Officers	2	45,000	1,080,000
Procurement Manager	1	90,000	1,080,000

Store Incharge	1	40,000	480,000
Accountant	1	80,000	960,000
Office Boy	2	25,000	600,000
Security Guard	4	25,000	1,200,000
Total	**39**		**19,080,000**

10. CONTACT DETAILS

The contact details of all the major suppliers of machinery and equipment used in the proposed project is given in Table 30.

Table 30: Contact Details

Name of Supplier	Supplies	City	Address	Contact
Shirazi Trading	Pig Iron	Lahore	Plot No، 67/A Khayaban-e-Iqbal, Sector XX DHA Phase 3, Lahore	(042) 111782 242
Arbaz WaseemMetal & Minerals Co.	Pig Iron	Karachi	Metal & Minerals Co. Pakistan Steel Mill Vicinity, Bin Qasim, Karachi.Chand Godown D-234, Haroonabad, Sher Shah Village, Karachi	(021) 35206662
Rastgar Engineering Co. (Pvt) Ltd.Mehta Brothers Pvt Ltd	Pig Iron	Rawalpindi	Plot No.307, Street 3, Industrial Area, I-9/3Office 3, 1st Floor, 5th Road Grace Plaza, Rawalpindi, Pakistan	(051) 4457285 (051)-4433544
Jiaxing Kingchan Machinery Co., LTD	Machinery	China	32-202 Linjiangjingyuan, Jiashan County, Jiaxing, Zhejiang, China 314100	
Fine Machinery Store	Machinery	Karachi	W25X+3Q3, Laloo Khait Block 10 Liaquatabad Town, Karachi	0300 2590764
Al-Noor Machinery	Machinery	Lahore	Opposite Ring Road, Shadbagh Underpass Near Meezan Flour Mills, Bhamma, Lahore	+92 321-8481392
Industryparts.pk	Testing Tools	Lahore	Brandrethroad Lahore Pakistan	(042) 37378060

New Star Supper	Copper Wire	Lahore	Harbanspura Lahore	0321 8857646
Paktherm (Pvt) Ltd.	Machinery	Lahore	11Km. Sharakpur Road Sagian, Moti Fouji Road, Near Almugni Trust Nain Sukh. Lahore. Pakistan	042 37934233
Karachi machinery store	Tools and Equipment	Lahore	1 Service Rd, Sharif Garden, Lahore	0321 4587514

11. USEFUL WEB LINKS

Table 31: Useful Links

Name of Organization	Link
Small and Medium Enterprises Development Authority (SMEDA)	www.smeda.org.pk
National Business Development Program (NBDP)	www.nbdp.org.pk
Government of Pakistan	www.pakistan.gov.pk
Securities and Exchange Commission of Pakistan	www.secp.gov.pk
State Bank of Pakistan	www.sbp.org.pk
Trade Development Authority of Pakistan	www.tdap.gov.pk
Federal Board of Revenue	www.fbr.gov.pk
Government of Punjab	www.punjab.gov.pk
Government of Sindh	www.sindh.gov.pk
Government of Khyber Pakhtunkhwa	www.kp.gov.pk
Government of Balochistan	www.balochistan.gov.pk
Government of Azad Jammu and Kashmir	www.ajk.gov.pk
Government of Gilgit Baltistan	www.gilgitbaltistan.gov.pk
Punjab Board of Investment and Trade	www.pbit.gop.pk/
Punjab Small Industries Corporation	www.psic.gop.pk
Sindh Small Industries Corporation	https://ssic.gos.pk
Small Industries Development Board Khyber Pakhtunkhwa	https://small_industries_de.kp.gov.pk
Directorate of Small Industries Balochistan	https://balochistan.gov.pk/departments
Industries Department Government of Khyber Pakhtunkhwa	www.industries.kp.gov.pk
Industries and Commerce Department Balochistan	www.dgicd.gob.pk
Industries and Commerce Department Sindh	www.industries.sindh.gov.pk
Department of Industries and Commerce AJ&K	www.industries.ajk.gov.pk
Pakistan Steel Melters Association (PSMA)	www.steelmelters.com
Pakistan Foundry Association	http://www.pfa.org.pk/
The Pakistan Steel Re-Rolling Mills Association	https://psrma.com

12. ANNEXURES

12.1 Income Statement

Calculations										SMEDA
Income Statement										
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenue										
Induction Motor	111,150,000	141,310,845	170,100,187	203,320,967	241,580,635	285,564,763	336,046,691	393,898,341	460,102,311	508,906,478
Synchronous Motor	47,310,000	60,147,693	72,401,618	86,541,745	102,826,629	121,548,078	143,035,258	167,659,294	195,838,419	216,611,475
Total Revenue	158,460,000	201,458,538	242,501,806	289,862,713	344,407,265	407,112,841	479,081,950	561,557,634	655,940,730	725,517,953
Cost of sales										
Induction Motor	80,541,000	102,396,012	123,257,213	147,329,501	175,053,045	206,924,620	243,504,603	285,424,798	333,397,213	368,761,463
Synchronous Motor	33,611,760	42,732,400	51,438,297	61,484,261	73,053,984	86,354,784	101,620,519	119,114,858	139,134,939	153,893,319
Direct Electricity	1,917,002	2,068,445	2,231,852	2,408,168	2,598,414	2,803,688	3,025,180	3,264,169	3,522,038	3,800,279
Gas Cost	324,291	381,334	444,705	515,005	592,890	679,070	774,321	879,484	995,472	1,064,160
Direct Labour	12,720,000	13,953,840	15,307,362	16,792,177	18,421,018	20,207,856	22,168,019	24,318,316	26,677,193	29,264,881
Consumables	626,950	691,526	762,753	841,317	927,972	1,023,553	1,128,979	1,245,264	1,373,526	1,515,000
Machinery repair and maintenance	782,600	863,208	952,118	1,050,186	1,158,356	1,277,666	1,409,266	1,554,420	1,714,525	1,891,122
Total cost of sales	130,523,603	163,086,764	194,394,300	230,420,615	271,805,678	319,271,239	373,630,887	435,801,309	506,814,907	560,190,223
Gross Profit	27,936,397	38,371,774	48,107,506	59,442,098	72,601,587	87,841,602	105,451,063	125,756,325	149,125,823	165,327,730
General administration & selling expenses										
Administration expense	6,360,000	6,976,920	7,653,681	8,396,088	9,210,509	10,103,928	11,084,009	12,159,158	13,338,597	14,632,440
Administration benefits expense	636,000	697,692	765,368	839,609	921,051	1,010,393	1,108,401	1,215,916	1,333,860	1,463,244
Building rental expense	4,050,000	4,455,000	4,900,500	5,390,550	5,929,605	6,522,566	7,174,822	7,892,304	8,681,535	9,549,688
Indirect electricity	683,865	737,890	796,184	859,082	926,950	1,000,179	1,079,193	1,164,449	1,256,440	1,355,699
Communications expense (phone, internet etc.)	636,000	697,692	765,368	839,609	921,051	1,010,393	1,108,401	1,215,916	1,333,860	1,463,244
Office vehicles running and maintenance expense	367,950	405,849	447,651	493,759	544,617	600,712	662,585	730,832	806,107	889,136
Office expenses (stationery, entertainment, janitorial services, etc.)	636,000	697,692	765,368	839,609	921,051	1,010,393	1,108,401	1,215,916	1,333,860	1,463,244
Promotional expense	3,169,200	4,029,171	4,850,036	5,797,254	6,888,145	8,142,257	9,581,639	11,231,153	13,118,815	14,510,359
Insurance expense	170,670	145,070	119,469	93,869	68,268	42,668	17,067	326,711	277,704	228,698
Professional fees (legal, audit, consultants, etc.)	636,000	697,692	765,368	839,609	921,051	1,010,393	1,108,401	1,215,916	1,333,860	1,463,244
Depreciation expense	2,138,173	2,138,173	2,138,173	2,188,911	2,184,478	2,184,478	1,648,376	3,887,625	3,887,625	3,975,568
Amortization of pre-operating costs	131,348	131,348	131,348	131,348	131,348	-	-	-	-	-
Bad debt expense	1,584,600	2,014,585	2,425,018	2,898,627	3,444,073	4,071,128	4,790,819	5,615,576	6,559,407	7,255,180
Subtotal	21,199,805	23,824,773	26,523,532	29,607,924	33,012,195	36,709,486	40,472,115	47,871,472	53,261,669	58,249,744
Operating Income	6,736,592	14,547,001	21,583,974	29,834,174	39,589,392	51,132,115	64,978,948	77,884,853	95,864,154	107,077,985
Gain / (loss) on sale of machinery & equipment	-	-	-	-	-	-	1,956,500	-	-	
Gain / (loss) on sale of office equipment	-	-	-	-	-	-	522,750	-	-	
Gain / (loss) on sale of office vehicles	-	-	-	-	-	-	141,500	-	-	
Earnings Before Interest & Taxes	6,736,592	14,547,001	21,583,974	29,834,174	39,589,392	51,132,115	67,599,698	77,884,853	95,864,154	107,077,985
Subtotal	-	-	-	-	-	-	-	-	-	-
Earnings Before Tax	6,736,592	14,547,001	21,583,974	29,834,174	39,589,392	51,132,115	67,599,698	77,884,853	95,864,154	107,077,985
Tax	2,376,900	3,021,878	3,637,527	4,347,941	5,166,109	6,106,693	7,186,229	8,423,365	9,839,111	10,882,769
NET PROFIT/(LOSS) AFTER TAX	**4,359,692**	**11,525,122**	**17,946,447**	**25,486,234**	**34,423,283**	**45,025,423**	**60,413,469**	**69,461,489**	**86,025,043**	**96,195,216**

12.2 Balance Sheet

Calculations											SMEDA
Balance Sheet											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Assets											
Current assets											
Cash & Bank	1,500,000	2,184,527	6,685,338	10,660,101	15,412,485	20,288,691	24,358,355	54,887,312	117,974,055	196,543,728	345,692,077
Accounts receivable		6,512,055	8,279,118	9,965,828	11,912,166	14,153,723	16,730,665	19,688,299	23,077,711	26,956,468	29,815,806
Finished goods inventory		6,008,040	7,289,555	8,771,323	10,481,000	12,449,815	14,713,014	17,310,351	20,286,649	23,692,420	26,132,739
Spares Inventory	65,217	78,840	95,308	115,217	139,285	168,379	203,552	246,071	297,473	359,611	-
Raw material inventory	4,756,365	6,669,860	8,855,672	11,675,471	15,301,354	19,950,229	25,895,149	33,479,460	43,134,446	52,623,932	-
Consumables inventory	52,246	63,563	77,331	94,082	114,461	139,254	169,417	206,115	250,761	305,078	-
Pre-paid building rent	-	371,250	408,375	449,213	494,134	543,547	597,902	657,692	723,461	795,807	-
Pre-paid insurance	170,670	145,070	119,469	93,869	68,268	42,668	17,067	326,711	277,704	228,698	-
Total Current Assets	6,544,498	22,033,204	31,810,167	41,825,102	53,923,152	67,736,306	82,685,120	126,802,011	206,022,261	301,505,742	401,640,622
Fixed assets											
Land	-	-	-	-	-	-	-	-	-	-	-
Building / Infrastructure	1,831,836	1,648,652	1,465,469	1,282,285	1,099,102	915,918	732,734	549,551	366,367	183,184	(0)
Machinery & equipment	7,826,000	6,652,100	5,478,200	4,304,300	3,130,400	1,956,500	782,600	14,866,671	12,636,670	10,406,670	8,176,669
Tools & Material Handling Equipment	443,300	297,011	150,722	588,052	391,025	198,430	774,190	514,797	261,240	1,019,246	677,747
Furniture & fixtures	1,575,000	1,338,750	1,102,500	866,250	630,000	393,750	157,500	2,991,951	2,543,158	2,094,366	1,645,573
Office vehicles	566,000	481,100	396,200	311,300	226,400	141,500	56,600	1,175,107	998,841	822,575	646,309
Office equipment	2,091,000	1,777,350	1,463,700	1,150,050	836,400	522,750	209,100	3,972,171	3,376,345	2,780,520	2,184,694
Security Against Building	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500	1,012,500
Total Fixed Assets	15,345,636	13,207,463	11,069,291	9,514,737	7,325,826	5,141,348	3,725,224	25,082,747	21,195,121	18,319,059	14,343,491
Intangible assets											
Pre-operation costs	656,739	525,391	394,043	262,696	131,348	-	-	-	-	-	-
Total Intangible Assets	656,739	525,391	394,043	262,696	131,348	-	-	-	-	-	-
TOTAL ASSETS	**22,546,872**	**35,766,058**	**43,273,501**	**51,602,535**	**61,380,326**	**72,877,655**	**86,410,344**	**151,884,758**	**227,217,382**	**319,824,801**	**415,984,113**
Liabilities & Shareholders' Equity											
Current liabilities											
Accounts payable		11,039,340	13,874,144	16,656,197	19,890,604	23,647,716	28,009,227	33,070,173	38,941,308	45,523,684	45,487,780
Total Current Liabilities	-	11,039,340	13,874,144	16,656,197	19,890,604	23,647,716	28,009,227	33,070,173	38,941,308	45,523,684	45,487,780
Other liabilities											
Total Long Term Liabilities	-	-	-	-	-	-	-	-	-	-	-
Shareholders' equity											
Paid-up capital	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872	22,546,872
Retained earnings		2,179,846	6,852,484	12,399,465	18,942,849	26,683,066	35,854,244	96,267,713	165,729,202	251,754,245	347,949,461
Total Equity	22,546,872	24,726,718	29,399,357	34,946,338	41,489,722	49,229,938	58,401,117	118,814,585	188,276,074	274,301,117	370,496,333
TOTAL CAPITAL AND LIABILITIES	**22,546,872**	**35,766,058**	**43,273,501**	**51,602,535**	**61,380,326**	**72,877,655**	**86,410,344**	**151,884,758**	**227,217,382**	**319,824,801**	**415,984,113**

12.3 Cash Flow Statement

Calculations Cash Flow Statement											SMEDA
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Operating activities											
Net profit		4,359,692	11,525,122	17,946,447	25,486,234	34,423,283	45,025,423	60,413,469	69,461,489	86,025,043	96,195,216
Add: depreciation expense		2,138,173	2,138,173	2,138,173	2,188,911	2,184,478	2,184,478	1,648,376	3,887,625	3,887,625	3,975,568
amortization of pre-operating costs		131,348	131,348	131,348	131,348	131,348	-	-	-	-	-
Accounts receivable		(6,512,055)	(1,767,063)	(1,686,710)	(1,946,339)	(2,241,557)	(2,576,941)	(2,957,635)	(3,389,412)	(3,878,757)	(2,859,338)
Finished goods inventory		(6,008,040)	(1,281,515)	(1,481,768)	(1,709,677)	(1,968,815)	(2,263,199)	(2,597,337)	(2,976,298)	(3,405,770)	(2,440,319)
Spares inventory	(65,217)	(13,623)	(16,469)	(19,909)	(24,067)	(29,095)	(35,172)	(42,520)	(51,401)	(62,138)	359,611
Raw material inventory	(4,756,365)	(1,913,495)	(2,185,812)	(2,819,799)	(3,625,883)	(4,648,875)	(5,944,919)	(7,584,312)	(9,654,986)	(9,489,487)	52,623,932
Consumables inventory	(52,246)	(11,317)	(13,768)	(16,751)	(20,379)	(24,793)	(30,164)	(36,697)	(44,646)	(54,317)	305,078
Pre-paid building rent	-	(371,250)	(37,125)	(40,838)	(44,921)	(49,413)	(54,355)	(59,790)	(65,769)	(72,346)	795,807
Advance insurance premium	(170,670)	25,601	25,601	25,601	25,601	25,601	25,601	(309,644)	49,007	49,007	228,698
Accounts payable		11,039,340	2,834,804	2,782,053	3,234,408	3,757,112	4,361,511	5,060,945	5,871,136	6,582,376	(35,904)
Other liabilities		-	-	-	-	-	-	-	-	-	-
Cash provided by operations	(5,044,498)	2,864,373	11,353,295	16,957,847	23,695,234	31,559,272	40,692,262	53,534,856	63,086,744	79,581,235	149,148,349
Financing activities											
Issuance of shares	22,546,872	-	-	-	-	-	-	-	-	-	-
Purchase of (treasury) shares											
Cash provided by / (used for) financing activities	22,546,872	-	-	-	-	-	-	-	-	-	-
Investing activities											
Capital expenditure	(16,002,375)	-	-	(583,619)	-	-	(768,353)	(23,005,899)	-	(1,011,562)	-
Acquisitions											
Cash (used for) / provided by investing activities	(16,002,375)	-	-	(583,619)	-	-	(768,353)	(23,005,899)	-	(1,011,562)	-
NET CASH	1,500,000	2,864,373	11,353,295	16,374,228	23,695,234	31,559,272	39,923,908	30,528,957	63,086,744	78,569,672	149,148,349

13. KEY ASSUMPTIONS

13.1 Operating Cost Assumptions

Table 32: Operating Cost Assumptions

Description	Details
Operating costs growth rate	10.3%
Communication expenses	10% of admin expense
Office expenses (stationery, entertainment, janitorial services, etc.)	10% of admin expense
Depreciation	
Building	10% of cost
Machinery and Equipment/Office Equipment/Office Vehicle/Furniture & Fixture	15% of cost

13.2 Revenue Assumptions

Table 33: Revenue Assumptions

Description	Details
Sale price growth rate	10.3%
Capacity utilization	50%
Capacity utilization growth rate	5%
Maximum capacity	90%

13.3 Financial Assumptions

Table 34: Financial Assumptions

Description	Details
Project life (Years)	10
Debt: Equity	0:100
Discount Rate with Equity	25%

13.4 Debt Related Assumptions

Table 35: Debt Related Assumptions

Description	Details
Project life (Years)	10
Debt: Equity	50:50
Discount Rate with Equity	22%
Debt Tenure	5 years
Grace Period	1 Year
Interest Rate (KIBOR+3%)	19%

13.5 Cash Flow Assumptions

Table 36: Cash Flow Assumptions

Description	Days
Accounts Payables	30
Accounts Receivables	15

Small and Medium Enterprises Development Authority

HEAD OFFICE

4th Floor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road, Lahore
Tel: (92 42) 111 111 456, Fax: (92 42) 36304926-7

www.smeda.org.pk, helpdesk@smeda.org.pk

REGIONAL OFFICE PUNJAB	REGIONAL OFFICE SINDH	REGIONAL OFFICE KPK	REGIONAL OFFICE BALOCHISTAN
3rd Floor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road Lahore, Tel: (042) 111-111-456 Fax: (042) 36304926-7 helpdesk.punjab@smeda.org.pk	5TH Floor, Bahria Complex II, M.T. Khan Road, Karachi. Tel: (021) 111-111-456 Fax: (021) 5610572 helpdesk-khi@smeda.org.pk	Ground Floor State Life Building The Mall, Peshawar. Tel: (091) 9213046-47 Fax: (091) 286908 helpdesk-pew@smeda.org.pk	Bungalow No. 15-A Chaman Housing Scheme Airport Road, Quetta. Tel: (081) 831623, 831702 Fax: (081) 831922 helpdesk-qta@smeda.org.pk