Pre-feasibility Study

HIGH PRESSURE DIE-CASTING MANUFACTURING UNIT

October 2022

"The figures and financial projections are approximate due to fluctuations in exchange rates, energy costs, and fuel prices etc. Users are advised to focus on understanding essential elements such as production processes and capacities, space, machinery, human resources, and raw material etc. requirements. Project investment, operating costs, andrevenues can change daily. For accurate financial calculations, utilize financial calculators on SMEDA's website and consult financial experts to stay current with market conditions."

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

Table of Contents

Table of Tables

Table of Figures

1. DISCLAIMER

This information memorandum is to introduce the subject matter and provide a general idea and information on the said matter. Although, the material included in this document is based on data / information gathered from various reliable sources; however, it is based upon certain assumptions, which may differ from case to case. The information has been provided on, as is where is basis without any warranties or assertions as to the correctness or soundness thereof. Although, due care and diligence has been taken to compile this document, the contained information may vary due to any change in any of the concerned factors, and the actual results may differ substantially from the presented information. SMEDA, its employees or agents do not assume any liability for any financial or other loss resulting from this memorandum in consequence of undertaking this activity. The contained information does not preclude any further professional advice to be obtained by the users. The prospective user of this memorandum is encouraged to carry out additional diligence and gather any information which is necessary for making an informed decision, including taking professional advice from a qualified consultant / technical expert before taking any decision to act upon the information.

For more information on services offered by SMEDA, please contact our website:

www.smeda.org.pk

Document Control

Document No.	258
Prepared by	SMEDA-Punjab (OS)
Revision Date	October 2022
For information	helpdesk.punjab@smeda.org.pk

2. EXECUTIVE SUMMARY

High Pressure Die Casting (HPDC) is a process wherein molten metal is forced, under high pressure, into a sealed mold cavity, which is then held in place by a compressive power, until the metal solidifies to produce the casting of the desired shape. HPDC is a casting process widely used to manufacture non-ferrous castings, mainly for the automotive industry.

Due to high-pressure, high speed of metal filling and rapid solidification rate, the high pressure die-casting process is very useful to manufacture large volumes of thin-walled nonferrous castings, when compared with manufacturing those using other die-casting methods such as gravity and low pressure die casting.

The components manufactured by high pressure die-casting have high volumes, high tolerance and high strength. Nonferrous products are light weight which makes them more suitable to be used in industries like automotive manufacturing. HPDC process produces parts with superior surface finish, excellent uniformity and optimal mechanical properties.

Die casting manufacturers, using HPDC, can produce high quality parts and components of complex shapes and stable dimensions. The most commonly used raw materials in the HPDC process are alloys of non-ferrous metals, mainly aluminum, magnesium and zinc. The material to be used in the proposed manufacturing unit is aluminum alloy (ADC 12).

This pre-feasibility study provides information for setting up a High Pressure Die-Casting Manufacturing Unit. The proposed products of this manufacturing unit are motorcycle parts, including crank case (both left and right), magnetic cover, clutch cover and car parts, including oil pump and water pump. These products have been selected as these are the products, commonly manufactured in Pakistan by HPDC.

The geographical potential for investment in this business is higher in big cities like Karachi, Lahore, Peshawar, Faisalabad, Sialkot, Hyderabad and Gujranwala. Easy availability of raw materials, presence of large growing market, availability of low-cost labor and availability of good industrial infrastructure in these cities make these locations suitable to establish this business. Ability to generate orders through strong networking, direct marketing and negotiating long-term contracts with institutional buyers, are the key success factors of the proposed business.

The maximum production capacity of the unit is 453,600 units, operating in a double shift of 12 hours for 300 days per year. Capacity utilization in “Year One” is assumed to be 50%, which translates into production of 226,800 units.

The proposed “High Pressure Die Casting Manufacturing Unit” will be set up in a rented building with an area of 6,750 square feet. (30 marla). The project requires a total investment of PKR 75.35 million. This includes capital investment of PKR 66.34 million and working capital of PKR 9.0 million. This project is financed through 100% equity. The Net Present Value (NPV) of the project is PKR 110.89 million with an

Internal Rate of Return (IRR) of 49% and a Payback period of 2.81 years. Further, this project is expected to generate Gross Annual Revenues of PKR 246.76 million during 1st year, with Gross Profit (GP) ratio ranging from 19% to 23% and Net Profit (NP) ratio ranging from 6% to 18% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at the capacity of 32% (146,926 number of units) with breakeven revenues of PKR 159.85 million.

The proposed project may also be established using leveraged financing. With 50% debt financing, at a cost of KIBOR+3%, the proposed manufacturing unit provides Net Present Value (NPV) of PKR 134.77 million, Internal Rate of Return (IRR) of 47% and Payback period of 2.97 years. Further, this project is expected to generate Net Profit (NP) ratio ranging from 5% to 17% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at capacity of 33% (151,469 units) with breakeven revenues of PKR 164.79 million.

The proposed project will provide employment opportunities to 55 people including the owner. High return on investment and steady growth of the business is expected with the entrepreneur having some prior experience or education in the related field of business. The legal business status of this project is proposed as “Sole Proprietorship”. Further, the proposed project may also be established as a “Partnership Concern”.

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 ‘sectoral 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 is 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 "High Pressure Die-casting Manufacturing Unit". 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

The proposed project involves setting up a High Pressure Die Casting (HPDC) manufacturing unit. With newer products being introduced in the world with the passing times, different types of castings, required for manufacturing such products are getting more and more complex. In addition to design, other desriable attributes in a casting are the required operational strength and efficient use of material. HPDC machines are the most efficient way of manufacturing such complex parts while achieving the required strength and material efficiency.

HPDC process uses a permanent metal mold, or die. Molten metal is forced into the die cavity at a pressure from 0.7 MPa[1] to 700 MPa. Die casting is the most suitable manufacturing technique for softer alloys. In the past, tin and lead were popular materials for manufacturing die-cast parts. Today, aluminum, zinc, brass and magnesium-based alloys are the most commonly used materials in HPDC processes. HPDC is used in a wide range of applications which includes manufacturing

[1] MPa stands for Megapascal, which is multiple of the pascal unit which is the SI unit for pressure. (1 megapascal=1,000,000 pascal units)

automotive parts, electrical and electronic components, different parts of industrial machinery, aerospace parts, aluminum furniture products, valves, telecommunication equipment, etc.

Another advantage of HPDC is that it generally does not require lot of machining[2] due to excellent dimensional accuracy and smooth surface finishes of the casting obtained through this technique. Compared to other manufacturing processes, high-pressure die casting is an efficient and economical process that:

- produces strong, lightweight parts that require less machining than fabricated parts
- creates complicated shapes in a single piece, eliminating the need for assembly or welding
- offers a broader range of shapes than that from other metal manufacturing techniques
- achieves close tolerances
- allows advanced production speed
- provides accurate dimensional stability
- provides variable wall thicknesses
- reduces wastage

There are two main die casting processes, hot chamber and cold chamber.

Hot chamber die casting machines are primarily used for zinc, copper, lead and other low melting point alloys. The injection mechanism of a hot chamber machine is dipped in a molten metal bath of a metal holding furnace. The furnace is attached to the machine by a metal feeding system called the gooseneck.

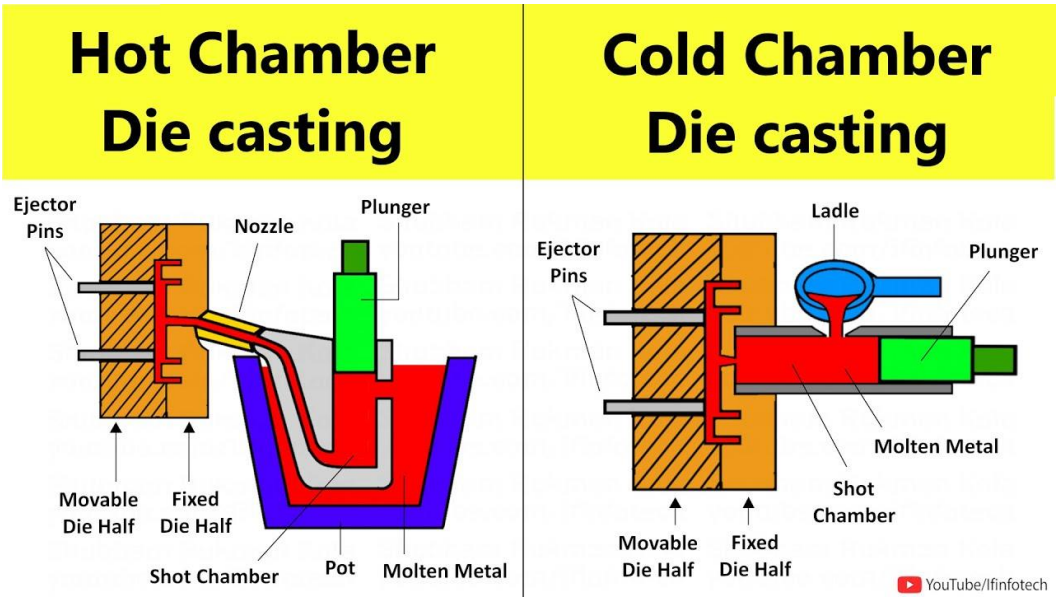
In cold chamber process process, molten metal is poured into the cold chamber by a ladle. A hydraulically operated plunger seals the cold chamber port and forces the metal into the die cavity at high pressure. This process is used for metals which have a high melting point, such as Aluminum, Magnesium and Copper and their alloys. It is due to this broader scope to handle diverse range of materials that cold chamber machines are generally more preferred by the users. Cold chamber machines are more commonly used with molds that have multiple cavities, which allows producing larger numbers of different types of castings at the same time. Pressure requirements for cold chamber castings are also typically higher than those of hot chamber die castings.

In cold chamber machine, the injection plunger and cylinder are not submerged in molten metal. The metal is heated in a separate furnace from where it is transferred into a 'cold chamber' of the casting machine through a port or pouring slot by a manual or automatic ladle. The machine uses a specialized plunger to force the metal into the cavity of the locked die. Cold chamber machinery thus requires additional equipment,

[2] Machining is the process of removing material from a work-piece using power-driven machine tools to shape it into an intended design and size.

which includes an outside furnace and a ladle to pour the metal into the machine. Schematic diagram showing comparison of Hot and Cold Chamber Die Casting is shown in Figure 1.

Figure 1: Comparison of Hot and Cold Chamber Die Casting3



In the proposed manufacturing unit, cold chamber die casting has being suggested. The raw material used for manufacturing the selected automotive parts is Aluminum Alloy (ADC 12). This aluminum material is cost-efficient and provides resistance to cracking under heat. It is perfect for components that enhance die-filling characteristics. It is easy to cast, and holds dimensional stability, which offers an ideal balance of value and performance of products. Some other advantages of ADC 12 include good corrosion resistance and good machinability due to higher silicon levels and lower levels of copper.

Proposed Products

A number of products can be manufactured using High Pressure Die Casting machine. The products to be manufactured in the proposed unit are motorcycle parts (Honda CD 70) and car parts (Suzuki Mehran, Bolan & Ravi). Following parts have been included for this study:

Motorcyle Parts

- Crank cases (left and right side)
- Magnetic cover
- Clutch cover

[3]https://www.youtube.com/watch?v=Uo_O0UQPiog

Car Parts

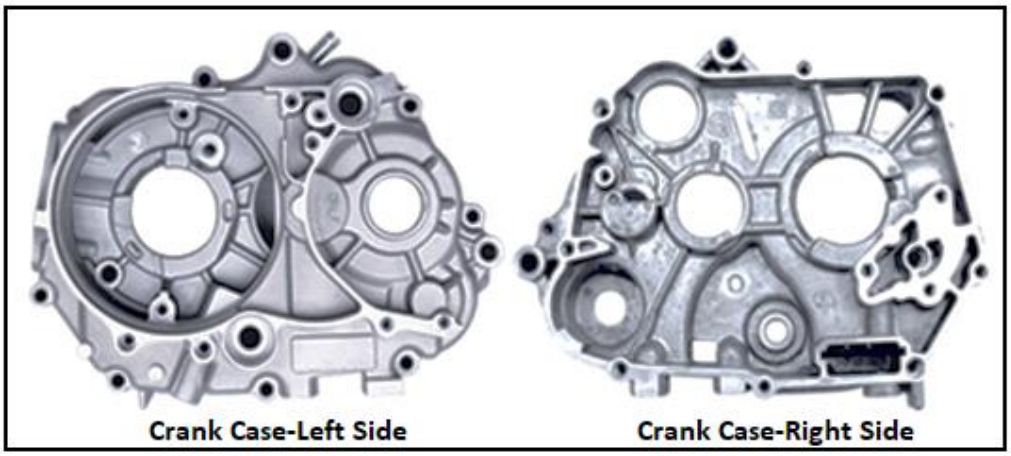
- Car Cap Thermostat
- Oil pump
- Water pump

A brief description of the proposed products is given below.

Motorcycle Crank Case (Left & Right)

A crankshaft converts the force generated by the combustion in the engine, into a rotary motion. The linear upwards and downwards motion of the pistons is converted into a force by the connecting rod and then transmitted to the fly wheel. In the proposed project, the cases of the crank shaft are manufactured, one is the left side case and other right side case. The crank cases of Honda CD 70 motorcyle are are shown in Figure 2.

Figure 2: Crank Case Left and Right Side



Motorcycle Magnetic Cover

A magnetic cover is used to cover the magnet and the magnetic coil of the engine which is vital in producing current for ignition of the bike. It also covers the gear box which gives the motorcyle capacity to shift up the gears and run in a smooth way. A magnetic cover of 70 cc motorcyle is shown in Figure 3.

Figure 3: Magnetic Cover

Bike Clutch Cover (Right Side)

The clutch allows to smoothly engage the spinning, running engine to the non-spinning transmission, which turns the wheels. A clutch cover protects the clutch mechanism of bike. Clutch cover of 70 cc motorcyle, being manufactured in the proposed project, is shown in Figure 4.

Figure 4: Clutch Cover

Car Cap Thermostat

In a car, a thermostat helps in regulating the coolant flow into the engine. Temperature of the engine is very important. If the temperature is high, it leads to engine knocking. Whereas, low temperatures decrease the efficiency of the engine. The cap thermostat regulates the maximum pressure, preventing damage to the hoses and radiator. After turning the engine off, the system cools and the coolant contracts significantly. The cap therefore has a return valve that admits air from the atmosphere or coolant from an expansion tank. Cap thermostat of Suzuki Mehran/Bolan/Ravi, being manufactured in the proposed project, is shown in Figure 5.

Figure 5: Cap Thermostat

Car Oil Pump

Oil pump is a part in an internal combustion engine that circulates engine oil under pressure to the rotating bearings, the sliding pistons and the camshaft of the engine. This lubricates the bearings, allows the use of higher-capacity fluid bearings and also assists in cooling of the engine. Oil pumps of Mehran/Bolan/Ravi, manufactured in the proposed project, are shown in Figure 6.

Figure 6: Oil Pump

Car Water Pump

A car's water pump is a belt-driven pump that derives its power from the engine's crankshaft. It is designed as a centrifuge,[4] which draws the cooled fluid through the pump's center inlet from the radiator. It then circulates the fluid outward into the engine and back into the car's cooling system. The water pump of Suzuki Mehran/Bolan/Ravi, being manufactured in the proposed project, is shown in Figure 7.

[4] *Centrifuge* is a device that spins a container round at high speed, causing the liquids of different densities inside it to separate.

Figure 7: Water Pump

Other Applications

Although the automotive industry accounts for majority of die casting products, HPDC technique has several other wide range of applications as well. These applications are mentioned as follows:

Telecommunication

There are a number of telecommunication equipments which are manufactured using HPDC. Aluminum is used as the raw material as its parts have high conductivity, low weight and high durability. Some of the applications are mentioned below:

- RF (Radio Frequency) filters
- Antenna mounts
- Front face plates
- Electrical housings

Industrial Equipment

HPDC parts are found in manufacturing plants of a wide range of industries. From wall mount bearing housings and air compressors to industrial pumps, porter cable pump housings and piston connecting rods, the machinery used in the industries have many parts manufactured using high pressure die casting.

Medical Devices

Some medical devices that are manufactured using HPDC are as follows:

- Gear boxes for hospital beds
- Parts for peristaltic pumps, oxygen pumps or insulin pumps
- Operating room robots
- Monitors
- Surgical tools

Aerospace Industry

The aerospace sector requires lightweight, high tensile structural components and complex parts. Use of aluminum HPDC allows aerospace manufacturers to build lighter and more fuel-efficient aircrafts.

Oil and Gas Sector

Oil and gas sector is dependent on HPDC components to produce drilling machinery, valves, flow controls, filtration devices, impellers, etc. The renewable energy sector utilizes a range of high pressure die-cast components such as wind turbine blades and solar panel brackets.

Electronics Industry

The rapid pace of innovation in the consumer electronics industry requires a constant supply of flexible, light, heat resistant and highly durable precision parts. The electronics industry incorporates high pressure die-casting components in everything from 5G base-station housings to smart phones to drones to personal computers and home appliances.

Paper Mills

Paper mills rely on a range of machinery made with high pressure die-cast components. These include heads used in paper machine dryers, pulleys, gears and housings.

Furniture Manufacturers

Die cast aluminum parts can be made cheaply from recycled materials, having precise and accurate shapes. This makes them ideal for metal furniture manufacturers.

Mechanical and Plant Engineering

HPDC is used to manufacture precise parts for industrial products such as machine tools, conveyors, pumps, lifting equipment and compressors.

Traffic Lights

HPDC is also used for making traffic lights. Aluminum alloys and casting dies are a great way to create lighting enclosures and other parts for traffic lights. Aluminum cast housings are much stronger than plastic housings for locations with hurricanes and high wind storms.

Outdoor Lighting

Just as aluminum die cast parts are an ideal choice for traffic lights, they are also a great option for all kinds of outdoor lighting. Die cast parts work for light housings as well as for a wide variety of light fixtures especially with LED lights that require heat dissipation in the fixture.

5.1. Machines used in Production

The machines used in High Pressure Die Casting are described as follows:

Gas Melting and Holding Furnaces

Two small capacity furnaces are used for small melting applications. The metal is placed or poured into a ceramic crucible which is contained in a circular furnace, fired by a gas burner. For the melting furnace, the heating fuel is typically gas, whereas for the holding furnace an electricity connection is required. Gas-fired crucible style furnaces offer the advantage of a high-volume melting capacity. They are perhaps the most flexible of all furnace styles. They offer faster start-ups, frequent cycling and temperature recovery. Control system is also equipped with leakage alarm, over-temperature alarm and other functions to ensure the safety of equipment and operation. For the proposed project, furnace has a melting capacity of 350 kg per hour and a holding capacity of 500 kg per hour with an electric power requirement of 500 watt for normal routine functions. The Furnace used in the proposed project is shown in Figure 8.

Figure 8: Melting and Holding Furnace

High Pressure Die-casting Machine (Cold Chamber)

The HPDC machine forces molten metal at high speed, and high pressure into a closed steel die cavity. The die has a stationary half and a moving half, both of which are mounted to the die casting machine's plates. The die casting machine has an injection end that uses hydraulics and pressurized gas to move a piston forward, injecting the molten metal into the closed steel die. The die casting machine also has a clamping end that utilizes hydraulics and mechanical toggles to absorb the injection pressure and keep the die shut while the part solidifies.

In the proposed project, the HPDC Cold Chamber machine has a clamping force[5] of 450 ton, having a die locking force[6] of 4,500 KN (Kilo-newton). The machine have an average cycle time of die-casting is 50 seconds per product Cold chamber has an ejection[7] and injection[8] force of 220 KN and 450 KN respectively. The cold chamber has a capacity to inject 2.8 kg of aluminum with a cast projection area[9] of 283 cm^2 (square centimeter). The cold chamber die casting machine has a dimension of 7,300 x 1,800 x 3,200mm with an electric consumption of 15 KW. HPDC machine is shown in Figure 9.

Figure 9: High Pressure Die-Casting Machine

Lathe Machine

A lathe machine 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 10 shows the lathe machine used in the proposed project.

[5] Clamping force is the force needed to hold the mold together during injection.
[6] Die locking force is the force which is used to keep both mold halves closed in a die casting.
[7] Force of ejection applied on the ejector equipment by ejector cylinder or ejector unit of a die casting machine.
[8] Injection force is the force that pushes the movement of the injection piston in the injection mechanism of the die casting machine.
[9] Cast projection area is an active surface of a casting including the gating system which is projected onto the parting plane of the permanent mold

Figure 10: Lathe Machine

Bench Drilling Machine

Bench drilling machine is used to drill or to 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 by a small amount but with a high degree of accuracy to leave smooth sides. The machine used in the proposed project drills holes up to 15 mm diameter. Figure 11 shows the bench drilling machine being used.

Figure 11: Bench Drilling Machine

Molds for Injection Molding

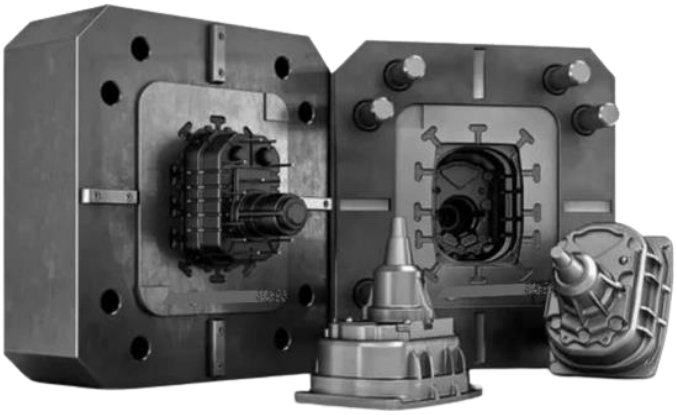
A mold is a hollow metal block into which molten metal is injected to form a certain fixed shape. There are many holes drilled in the block for temperature control by circulating water or oil or by using heaters. Molten metal flows into the mold through a sprue and fills the cavities by way of runners and gates. The mold is then opened after cooling and the ejector rod of the injection molding machine pushes the ejector plate of the mold to further eject moldings. The die material used for HPDC are made of a special type of steel called hot work tool steels, AISI[10] grade H.[11] These steels are made to withstand combinations of pressure, heat and abrasion.[12] The tool steels are used in a hardened and tempered condition. Hot strength, ductility, toughness, creep strength, thermal conductivity, temper resistance and low thermal expansion are the fundamental properties for the hot work tool steels. Molds used in the proposed project have an estimated life of around 800,000 cycles. A mold for HPDC is shown in Figure 12.

[10] AISI stands for American Iron and Steel Institute

[11] Grading of AISI materials is basic four-digit system to designate the chemical composition of alloy steels and carbon steels.

[12] Abrasion of metals occurs when friction wears, grinds or rubs away metal. It is an undesirable effect to the regular and normal use of a machine or part.

Figure 12: Mold for High Pressure Die Casting



Electric Chain Pulley

An electric chain pulley is used for lifting or moving heavy objects. An electric motor and controller are used to lift, lower and accelerate or decelerate the speed of the pulley. Electric chain pulleys are ideal for use in industrial production lines and small machine shops where more frequent and faster lifting is required. The electric chain pulley used in the proposed project is used to lift molds for injection molding machine and other heavy objects. An electric chain pulley is shown in Figure 13.

Figure 13: Electric Chain Pulley

Weigh Scale

Weigh scale is a device used to measure quantities of raw materials, which afterwards are put into furnance. Weigh scale used in the proposed project is shown in Figure 14.

Figure 14: Weighing Scale

Material Handling Trolley

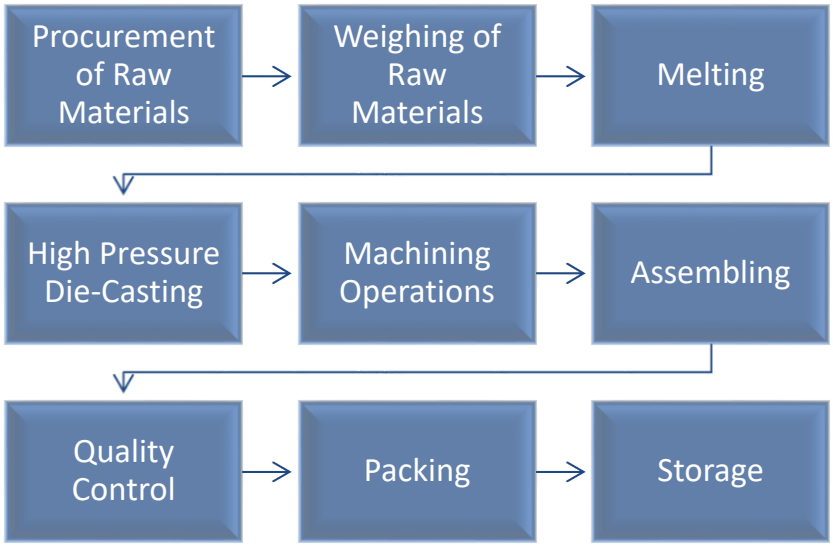
Material handling trollies are used to transport heavy items around workplace. A material handling trolley is shown in Figure 15.

Figure 15: Material Handling Trolley

5.2. Production Process

The production process flow of High Pressure Die Casting is shown in Figure 16.

Figure 16: Process Flow



Procurement of Raw Materials

The proposed project manufactures aluminum products for which the required raw material is purchased in the form of aluminum ingots and scrap aluminum. The aluminum used for production of these products is specified as ADC 12. It is an alloy used in manufacturing die-casting components. Also known as A 383, this aluminum material is cost-efficient and facilitates manufacturing processes. Scrap aluminum is waste aluminum or used articles made of aluminum. Scrap aluminum and aluminum ingots are procured from different metal importers and local dealers located in major cities like Lahore, Karachi, Rawalpindi, Quetta, Peshawar, Multan Gujranwala, etc. Figure 17 shows aluminum ingots and scrap aluminum used in HPDC.

Figure 17: Aluminum Ingots and Scrap Aluminum

Aluminum Ingots *Aluminum Scrap*

Other components for manufacturing the automotive products proposed in this study include screws, bolts, gears, shafts, lock pins, lock plates, springs, washers, relief valves, seals, rings, bearings, seals, seat pulley and gaskets. These components are readily available in the markets of large cities. These components are procured by the procurement team of the proposed unit.

Weighing

A weigh scale is used to measure the quantities of raw materials for processing. Pure and/or scrap aluminum is measured in required proportions, ready to be melted and mixed afterwards. Material handling trollies are then used to transfer material to the furnace for melting.

Melting Process

Melting of the metal includes the following steps:

- ***Preparation of metal***
  Cast aluminum ingots and scrap aluminum are the main raw materials used in the melting process. Before loading into the furnace, ingots and aluminum scrap are cleaned of any dirt. At this stage, some vital precautions are necessary to prevent any damages and injuries to the workers. One of the most common injuries is from molten metal splash. It is caused by the addition of wet materials to the molten bath. It can be minimized by diligently inspecting and treating scrap. Hence, the metals are dried to remove the moisture. Another important precaution in using scrap metal is removing the paint, machining oil, and any other contaminants, if present.

- **Loading and melting the metal**
  Metal is continuously loaded by labor into the furnace in the heating process instead of doing it batch-wise to save the energy consumption and work effectiveness. This requires mandatory use of protection equipment by the worker. The loaded metal melts at around 600 degree Celsius. The operations of the furnace are controlled at the control panel of the furnace. Figure 18 shows melting process.

Figure 18: Aluminium Melting Process

- **Transporting the Molten Metal**
  After melting, the molten liquid is transported from the furnace to the molding line with the help of a furnace ladle. Figure 19 shows transfer of molten metal.

Figure 19: Transfer of Molten Metal

<u>High Pressure Die Casting Process</u>

The standard die casting application process consists of injecting high pressure molten metal into a steel mold called a die. A complete die casting cycle for the proposed products can take up to 50 seconds. Following processes are routinely used to create custom die casting applications. Usually this process follows two 12 hours shifts in a day. During these 24 hours, around 1.5 hours per shift is considered an average time duration required for machine preparation and changing of molds and some regular mantainance.

- **Clamping**

The first step in the die casting process involves the preparation and clamping of two die halves. Once cleaned and properly prepared, the two clean die halves are lubricated to prevent sticking and then closed, securely clamping them together. This is an important step because the lubricant regulates the mold's temperature while also creating a film between the molten metal and the mold, thereby allowing for easier removal of the casting.

- **Injection**

Once transferred from the chamber, the liquid metal is injected at high speed and high pressure into the metal mold. The total injection time required for a project depends upon the length of time required to fill all the cavities and channels within the die. The correct duration of injection time can be determined by the thermodynamic properties of the material, as well as the wall thickness of the casting. Greater wall thickness requires a longer injection time and vice versa.

- **Cooling**

The cooling process begins the moment the molten metal enters the die cavity. Once the entire cavity of the mold is filled and the molten metal solidifies, the final shape of the casting is formed. It is important that the die should not be opened until it has completely cooled. This ensures that the casting is completely solidified. Greater wall thickness will require a longer cooling time. Additionally, the geometric complexity of the die also requires a longer cooling time due to the additional resistance to the flow of heat.

- **Ejection**

Once the proper amount of cooling time has elapsed, the die halves can be opened and ejected from the die cavity. Once the casting is ejected, the die can be clamped shut for the next injection.

- **Trimming**

Excess material and flash must be trimmed from the channels of the die due to solidification during the casting process. This is accomplished either manually or through the assistance of trim die, a saw or trimming press. The scrap material that results from this trimming may be sold or reused in the die casting process.

Machining

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 tool. Two major machining operations are usually required on the parts made through HPDC process:

- Lathe Operations
- Drilling

Lathes are used primarily for the production of cylindrical or conical exterior and interior surfaces of cast body of products, via turning, facing, boring, and drilling. Lathes are also used for production of screw threads. In a lathe, the HPDC product is rotated while the cutting tool is moved into the product in a direction parallel and/or perpendicular to the axis of rotation of the product.

Drilling machine is used to drill holes in the HPDC product according to the required design inside the body and sides for fixing pins and nuts and bolts. The scrap material that results from machining operations is sold afterwards. Machining process is shown in Figure 20.

Figure 20: Machining Operations

Assembling

The manufactured components are assembled with other mechanical and electrical components by manual labor, to make the complete product. Different types of automotive products require different types of components.

Quality Control

Each assembled product is checked manually by an experienced and skilled person for any visible anomalies and irregularities in the final products.

Packing

Finished products are packed first in polythene bags and then in corrugated boxes by the workers manually. After packing the finished products, they are sent for storage in the finished goods store. Packed auto parts products are shown in Figure 21.

Figure 21: Packed Auto Parts Products

Storage

The finished products are then stored and are ready to be dispatched.

5.3. Installed and Operational Capacities

The proposed manufacturing unit shall, at maximum capacity of 100%, produce 453,600 units. The manufacturing unit would operate for 24 hours per day, working in two 12 hour shifts per day for 300 working days in a year. The project is assumed to attain a capacity utilization of 50% during first year of operations, to produce 226,800 units. During the projected period of 10 years, the facility will continue to operate with 5% annual increase in capacity utilization each year to achieve maximum capacity of 90% on the 9th year of operations. Table 1 and Table 2 shows installed and operational capacities of the proposed manufacturing unit.

Table 1: High Pressure Die Casting Machine Capacity

Machine hours per day	Machine Prepration Time (Hours)	Available Machine Time per day	Available time per day (seconds)	Cycle time per batch (seconds)	Machine Capacity/ Day (Units)
A	*B*	*C=(A-B)*	*D= (C*60*60)*	*E*	*F=(D/E)*
24	3	21	75,600	50	1,512

Table 2: Installed and Operational Capacity

Products	Machine Capacity/ day (units)	Machine Capacity / Annum (units)	Production Ratio	Production of Complete Set/ Annum (units) @100%	Production of Complete Set/ Annum (units) @ 50%
Calculations	*A (*Table 1*)*	*B=(A*300)*	*C*	*D=(B*C)*	*E=(D*50%)*
Motorcycle 70 cc					
Crank Case LH			20%	90,720	45,360
Crank Case RH			20%	90,720	45,360
Magnetic Cover			15%	68,040	34,020
Clutch Cover	1,512	453,600	15%	68,040	34,020
Car Parts (Mehran/Bolan/Ravi)					-
Water Pump Body			10%	45,360	22,680
Oil Pump Body			10%	45,360	22,680
Cap Thermostate(Set of 4)			10%	45,360	22,680
Total			**100%**	**453,600**	**226,800**

6. CRITICAL FACTORS

Following factors should be taken into account while making investment decision:

- Good technical knowhow and knowledge of the industry
- Availability of specialized workforce
- Knowledge of market demand and supply
- Government policies encouraging import over localization
- Selection of appropriate machinery and human resources
- Rigorous supervision of the production process
- Ability to generate work orders through networking
- Assurance of timely order fulfillment
- Compliance with international quality control standards

7. GEOGRAPHICAL POTENTIAL FOR INVESTMENT

The demand for setting up the HPDC Manufacturing Unit is higher in large cities. Majority of manufacturing units of automobile and other related industries are located in the big cities of Pakistan. The areas of Pakistan where major manufacturing related activities are being carried out and where raw materials are readily available, are the suitable locations for this manufacturing business. Therefore, the geographical potential for investment in this business is higher in big cities like Karachi, Lahore, Peshawar, Faisalabad, Sialkot, Hyderabad, Gujranwala, etc.. The ideal location for the project may be outside municipal and cantonment limits, preferably in small industrial clusters/estates.

8. POTENTIAL TARGET MARKETS

The global high-pressure die casting market was valued at USD 13,787.1 million in 2021 and is expected to reach USD 19,500 million in 2027 by registering a CAGR of above 6% during the forecast period (2022 - 2027).[13]

Automotive industry is the most important segment dominating the High Pressure Die Casting Machine market in Pakistan. The automobile parts that are manufactured by the HPDC method include engine blocks, gearbox housing, crankcase, clutch shoe, valve bodies, alloy wheels, and others. Due to the rising demand of the automotive industry, the proposed project will be feasible. Pakistan's Automobile industry contributes (2.8%) to its GDP and PKR 30 billion to the national treasury in terms of taxes and duties and employs a workforce of over 3.5 million people as of 2018.

[13] https://www.mordorintelligence.com/industry-reports/high-pressure-die-casting-market

Pakistan is the 35th largest producer of automotive vehicles in the world.[14] Pakistan's automobile industry has been ranked one of the fastest growing industries in Asia.

The production and sales have both grown by 171% and 172.5% respectively between 2014 and 2018,[15] primarily fueled by the Automotive Development Policy introduced in 2016. Despite economic challenges, auto sector in the country is expected to gear up with more sales in the coming years. In the calendar year 2021, auto companies, which are registered with Pakistan Automotive Manufacturers Association (PAMA), sold more than 210,048 units as compared to 110,540 units during last year. Meanwhile, volumes of two wheelers increased by 30% year on year to 1,707,348 units in the calendar year 2021 compared to 1,317,635 units during the same period last year.[15]

Other than the automobile sector, there are other applications of high pressure die-casting technology. Following are the other major potential target customers of High Pressure Die Casting market.

- Telecommunication
- Industrial Equipment
- Medical Devices
- Recreational Vehicles
- Traffic Lights
- Construction
- Outdoor Lighting
- Firearms
- Aerospace Industry
- Oil and Gas sector
- Electronics Industry
- Culinary Industry
- Paper Mills
- Furniture Manufacturers
- Mechanical and Plant Engineering

Any industry that has to deal with aluminum, magnesium, zinc or brass alloy parts requires high pressure die casting machine. Various types of metal parts are used in almost every industry that can be manufactured by high pressure die-casting, the market demand is directly proportional to the growth of high pressure die casting process in the market.

[14] https://invest.gov.pk/automobiles
[15] https://invest.gov.pk/automobiles

The demand and existence of market for the aluminum parts produced by high pressure die casting machine is clearly evident from the industrial production in Pakistan and manufacturing sector. Industrial production in Pakistan increased 27.01% in March of 2022 over the same month in the previous year.[16] Manufacturing sector in Pakistan increased 8.20% in January of 2022 over the same month in the previous year.[17] Growth in the aforementioned industries and manufacturing sector is expected to directly generate demand for high pressure die casting products.

9. PROJECT COST SUMMARY

A detailed financial model has been developed to analyze the commercial viability of "High pressure Die-casting Manufacturing Unit". Various costs and revenue related assumptions along with results of the analysis are outlined in this section.

The projected Income Statement, Cost of Goods Sold, Cash Flow Statement and Balance Sheet are attached as Annexure.

9.1. Project Economics

All the figures in this financial model have been calculated after carefully taking into account the relevant assumptions and target market.

9.2. Project Cost

Total cost of the project has been calculated to be PKR 75.35 million. The project will be financed through 100% Equity. Table 3 provides the details of the costs calculated for the proposed manufacturing unit.

Table 3: Project Cost

Description of Costs	Amount (PKR)	Reference
Land		9.2.1
Building Rennovation	1,058,000	9.2.2
Machinery & equipment	57,350,000	9.2.3
Allied Equipment	470,000	9.2.4
Furniture & fixtures	1,887,000	9.2.5
Office equipment	2,609,000	9.2.6
Office vehicles	535,300	9.2.7
Pre-operating costs	1,221,255	9.2.8
Security Against Building	1,215,000	9.2.9

[16] https://tradingeconomics.com/pakistan/industrial-production
[17] https://tradingeconomics.com/pakistan/manufacturing-production

Total Capital Cost	**66,345,555**	
Working Capital		
Spares inventory	119,479	
Raw material inventory	7,299,539	
Upfront insurance payment	586,883	
Cash	1,000,000	
Working Capital	**9,005,901**	
Total Project Cost	**75,351,456**	

9.2.1. Land

The manufacturing unit will be established in a rented building to avoid the high cost of land. Suitable places for setting up a business like this can be easily found on rent. Therefore, no land cost has been added to the project cost. Total space requirement for the proposed unit has been estimated as 6,750 sq. ft. The required space breakup is shown in Table 4.

Table 4: Breakup of Space Requirement

Break-up of Land Area	% Break-up	Area (Sq. Ft.)
Raw Material Store Room	11%	750
Production Department	48%	3,250
Foundry	9%	600
Finished Goods Store Room	11%	750
Reception Area	1%	50
Executive Office	2%	150
Conference Room	4%	300
Admin and Accounts Department	2%	150
Sales and marketing Department	2%	150
Parking and Gate area	6%	400
Washroom	3%	200
Total Area	**100%**	**6,750**

9.2.2. Building

There will be no cost of building since the unit will be started in a rented premises. However, there will be a renovation cost; required to make the building usable for the business. The proposed project requires electricity load of 51 KW for which an electricity connection under the General Supply Tariff-Industrial will be required.

Building rent of PKR 405,000 per month has been included in the operating cost. Building renovation cost is shown in Table 5.

Table 5: Building Renovation Cost

Cost Item	Unit of Measurement	Total Units	Cost/Unit (PKR)	Total Cost (PKR)
Paint Cost	Liter	149	800	119,000
Labour Cost	Sq. Feet	14895	15	223,000
Curtains	No.	7	6000	42,000
Blinds	No.	4	7000	28,000
Glass Partition and Doors	Sq. Feet	1035	550	569,000
Floor Tiles Cost	Sq. Feet	450	150	68,000
Labor Tile Cost	Sq. Feet	450	20	9,000
TOTAL (PKR)				**1,058,000**

9.2.3. Machinery and Equipment

Table 6 provides details of machinery and equipment required for the project.

Table 6: Machinery and Equipment

Cost Item	Units	Unit Cost (PKR)	Total Cost (PKR)
HPDC Machine (Hot chamber 420 ton - 50Sec/ Cycle	1	20,000,000	20,000,000
Molds for HPDC Machine	7	4,000,000	28,000,000
Gas Melting and Holding Furnace	1	6,000,000	6,000,000
Electric (static) Chain Pulley 500 kg	1	300,000	300,000
Bench Drill Machine	1	450,000	450,000
Lathe Machine	2	1,300,000	2,600,000
Total Cost (PKR)			**57,350,000**

9.2.4. Allied Equpiment

Table 7 provides the details of allied equipment.

Table 7: Allied Equipment

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Weighing Scale	2	40,000	80,000
Mechanical Tool Kits	6	30,000	180,000
Electrical Tool Kits	6	20,000	120,000
Material Handeling Trolly	6	15,000	90,000
Total Cost (PKR)			**470,000**

9.2.5. Furniture & Fixtures

Table 8 provides details of the furniture and fixture requirement of the project.

Table 8: Furniture and Fixtures

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Executive Tables	1	60,000	60,000
Executive Chairs	1	30,000	30,000
Office Table	10	30,000	300,000
Office Chairs	31	15,000	465,000
Visitor Chairs	24	13,000	312,000
Sofa Set	2	45,000	90,000
Racks	42	15,000	630,000
Total			**1,887,000**

9.2.6. Office Equipment

Details of office equipment required for the project is provided in Table 9.

Table 9: Office Equipment

Cost Item	Units	Unit Cost (PKR)	Total Cost (PKR)
Laptops	7	150,000	1,050,000
Desktop Computers	9	50,000	450,000
Printer	2	50,000	100,000
CCTV Cameras (2MP)	18	2,500	45,000

DVR	2	15,000	30,000
LED TV (32")	1	40,000	40,000
Air Conditioners 1.5 ton	5	110,000	550,000
Exhaust Fan	13	4,500	58,500
Bracket Fan	6	7,000	42,000
Ceiling Fan	12	8,000	96,000
Pedastal Fan	9	10,000	90,000
Water Dispenser	2	25,000	50,000
Wi-Fi / Internet Router	2	3,500	7,000
Total Cost (PKR)			**2,609,000**

9.2.7. Office Vehicles

Details of office vehicles required for the project is provided in Table 10.

Table 10: Office Vehicles

Cost Item	Unit	Unit Cost (PKR)	Registration and License Plate Charges (PKR)	Total Cost (PKR)
Car 1300 cc	1	3,600,000	80,000	3,680,000
Loader - Rickshaw (150 cc)	1	300,000	13,000	313,000
Motorcycle	2	115,000	6,500	236,500
Total				**4,230,000**

9.2.8. Pre-Operating Cost

Details of pre-operating cost for the project are provided in Table 11.

Table 11: Pre-Operating Cost

Cost Item	Number of Months	Total Cost (PKR)
Administration exp.	1	540,000
Utilities exp.	1	107,755
Machinery Installation Cost		573,500
Total		**1,221,255**

9.2.9. Security against Building

Detail of security against rented building for the project is provided in Table 12.

Table 12: Security against Building

Cost Item	Months	Unit Cost/Month (PKR)	Total Cost (PKR)
Security against Building	3	405,000	**1,215,000**

9.3. Financial Feasibility Analysis

The financial feasibility analysis given in Table 13 provides the information regarding projected IRR, NPV and payback period of the study based on 100% equity.

Table 13: Financial Feasibility Analysis

Description	Project
IRR	49%
NPV (PKR)	110,887,248
Payback Period (years)	2.81
Projection Years	10
Discount Rate used for NPV	25%

9.4. Financial Feasibility Debt Financing

Table 14 provides the information regarding projected IRR, NPV and payback period of the study based on combination of equity (50%) and debt (50%) financing for the proposed project.

Table 14: Financial Feasibility Debt Financing

Description	Project
IRR	47%
NPV (PKR)	134,778,231
Payback Period (years)	2.97
Projection Years	10
Discount Rate used for NPV	22%

9.5. Breakeven Analysis

Breakeven analysis is provided in Table 15.

Table 15: Breakeven Analysis

Description	Amount First Year (PKR)	Ratios
Sales (PKR) – A	246,758,400	100%
Variable Cost (PKR) – B	204,046,564	83%

Contribution (PKR) (A-B) = C	42,711,836	17%
Fixed Cost (PKR) – D	27,669,628	11%
Contribution Margin		17%
Breakeven Revenue (PKR)		159,855,299
Number of units at Breakeven		146,926
Breakeven Capacity		32%

9.6. Revenue Generation

Based on the 50% capacity utilization of the unit, sales revenue during the first year of operations is estimated in Table 16. Finished goods inventory in the proposed project is assumed to be kept for 8 days.

Table 16: Revenue Generation

Product	Quantity Sold (Units)	Sale Price Per Unit (PKR)	Total Revenue (PKR)
	A	*B*	*A*B*
Motorcycle 70 cc			
Crank Case LH	45,360	1,305	59,194,800
Crank Case RH	45,360	1,170	53,071,200
Magnetic Cover	34,020	1,260	42,865,200
Clutch Cover	34,020	380	12,927,600
Car Parts (Mehran/Bolan/Ravi)			
Water Pump	22,680	1,650	37,422,000
Oil Pump	22,680	1,725	39,123,000
Cap Thermostate(Set of 4)	22,680	95	2,154,600
Total			**246,758,400**

9.7. Scrap Sales

The scrap aluminum left in the HPDC and machining processes is sold afterwards. Detailed calculations regarding the scrap sales are shown in Table 17,Table 18 and Table 19.

Table 17: Scrap Sales

Product	Quantity Sold (Units)	Total scrap per Unit (grams)	Scrap per Year (KG)	Scrap Rate per Kg (PKR)	Total Scrap sales (PKR)
	A	***B* (Table 19*)***	***C=(A*B)/1000***	***D***	***E=(C*D)***
Motorcycle 70cc					
Crank Case LH	45,360	137	6,214	120	745,718
Crank Case RH	45,360	112	5,080		609,638
Magnetic Cover	34,020	154	5,239		628,690
Clutch Cover	34,020	33	1,123		134,719
Car Parts (Mehran/Bolan/Ravi)		-			
Water Pump	22,680	29	658		78,926
Oil Pump	22,680	78	1,769		212,285
Cap Thermostat(Set of 4)	22,680	4	91		10,886
Total			**20,174**		**2,420,863**

Table 18: Raw Material/Scrap Calculation

Product	Raw Material Required (Grams)	Wastage in HDPC Machine 5% (Grams)	Gross Weight after HDPC Machining	Wastage in Machining Process 5%(Grams)	Finished Product Weight (Grams)
	A	***B=(A*5%)***	***C=B-A***	***D=(C*5%))***	***E=C-D***
Motorcycle 70cc					
Crank Case LH	1408	70	1338	67	1271
Crank Case RH	1147	57	1090	55	1035
Magnetic Cover	1574	79	1495	75	1420
Clutch Cover	344	17	327	16	311
Car Parts (Mehran/Bolan/Ravi)					
Water Pump	300	15	285	14	271
Oil Pump	809	40	769	38	731
Cap Thermostate(Set of 4)	89	4	85		85

Table 19: Scrap Calculation

Product	Total Scap per piece (Grams)
	*(*Table 18*) (B+D)*
Motorcycle 70 cc	
Crank Case LH	137
Crank Case RH	112
Magnetic Cover	154
Clutch Cover	33
Car Parts (Mehran/Bolan/Ravi)	-
Water Pump	29
Oil Pump	78
Cap Thermostate(Set of 4)	4
Total	

9.8. Variable Cost Estimate

Variable costs of the project have been provided in detail in Table 20.

Table 20: Variable Cost Estimate

Variable Cost	Cost (PKR)
Material Cost (Table 21)	131,327,179
Other components Cost	42,933,240
Packing Cost	928,519
Consumables (Table 26)	205,000
Electricity	2,668,462
Direct Labour	18,840,000
Gas Expense	2,298,226
Machinery repair and maintenance	1,433,750
Vehicle running and maintenance cost	1,131,900
Distribution and selling expenses	-
Communications expense (phone, internet etc.)	429,600
Promotional expense	1,233,792
Bad debt expense	616,896
Total Variable Cost	**204,046,564**

Table 21: Material Cost

Material	Quantity Produced (Units)	Cost/Unit (PKR)	Total Cost (PKR)
	A	*B (Table 22)*	*C=(A*B)*
Motorcycle 70CC			
Crank Case LH	45,360	625.8	28,386,288
Crank Case RH	45,360	606.8	27,524,448
Magnetic Cover	34,020	665.8	22,650,516
Clutch Cover	34,020	147.08	5,003,662
Car Parts (Mehran/Bolan/Ravi)			
Water Pump	22,680	922.08	20,912,774
Oil Pump	22,680	1144.8	25,964,064
Cap Thermostate(Set of 4)	22,680	39.04	885,427
Total			**131,327,179**

Table 22: Total Raw Material Cost per Unit

Types	Raw Material Cost per Piece (PKR)	Other Component Cost (PKR)	Packing Cost (PKR)	Total Material Cost (PKR)
	A	***B (*Table 23*)***	***C***	***D= (A+B+C)***
Motorcycle 70 cc				
Crank Case LH	591	30.00	4.8	625.8
Crank Case RH	482	120.00	4.8	606.8
Magnetic Cover	661		4.8	665.8
Clutch Cover	144		3.08	147.08
Car Parts (Mehran/Bolan/Ravi)				
Water Pump	126	793.00	3.08	922.08
Oil Pump	340	800.00	4.8	1144.8
Cap Thermostat (Set of 4)	37		2.04	39.04

Table 23: Cost of Other Components

Products	Total Cost (PKR)	Quantity Produced per Annum	Cost per Annum (PKR)
	A	***B***	***C=(A*B)***
Crank Case LH		45,360	1,360,800
Bolt hex	30		
Total Cost (PKR)	**30**		
Crank Case LH		45,360	5,443,200
Bolt hex	120		
Total Cost (PKR)	**120**		
Oil Pump		22,680	18,144,000
Finish relief valve body	72		
Finish drive gear	70		
Finish drive shaft large	85		
Finish idler shaft small	47		
Grub screw	20		
Bolt hex	18		
Spring	15		
Silver bush	75		
Pvc cap	4		
Washer plain	12		
Piston oil pump	25		
Gear annulus	310		
Dowel pin	5		
Lock pin	7		
Lock plate	5		
Elkey bolt	30		
Total Cost (PKR)	**800**		
Water Pump		22,680	17,985,240
Front seal	180		
Finish impeller	105		
Finish shaft	190		
Bearing	265		

Nut hex	22		
Cotter 3.97mm	5		
Rubber seal water pump	6		
Washer plain 30mm	4		
Inside lock ring	12		
Spring washer	4		
	793		
Total Cost (PKR)			**42,933,240**

Table 24: Packing Cost-1

Products	Polythene price bags/per piece (PKR)	Corrugated Box price per 10 piece (PKR)	Corrugated Box price per 1 piece (PKR)	Total Packing Cost per Piece (PKR)
Motorcycle 70CC				
Crank Case LH	1.8	30	3	4.8
Crank Case RH	1.8	30	3	4.8
Magnetic Cover	1.8	30	3	4.8
Clutch Cover	1.08	20	2	3.08
Car Parts (Mehran/Bolan/Ravi)				
Water Pump	1.08	20	2	3.08
Oil Pump	1.8	30	3	4.8
Cap Thermostat (Set of 4)	0.54	15	1.5	2.04

Table 25: Packing Cost-2

Products	Total Packing Cost (PKR)	Quantity Produced per Annum	Total Cost per Annum (PKR)
	A	***B***	***A=(B*C)***
Motorcycle 70CC	Table 24		
Crank Case LH	4.8	45,360	217,728
Crank Case RH	4.8	45,360	217,728
Magnetic Cover	4.8	34,020	163,296

Clutch Cover	3.08	34,020	104,782
Car Parts (Mehran/Bolan/Ravi)			
Water Pump	3.08	22,680	69,854
Oil Pump	4.8	22,680	108,864
Cap Thermostat (Set of 4)	2.04	22,680	46,267
Total Cost (PKR)			**928,519**

Table 26: Consumables

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Ladle for Furnace	4	5,000	20,000
Foundry Gloves	10	2,500	25,000
Crucible Tongs	5	2,000	10,000
Die release agent (20 kg bucket)	30	5,000	150,000
Total Cost (PKR)			**205,000**

9.9. Fixed Cost Estimate

Table 27 provides details of fixed cost for the project.

Table 27: Fixed Cost Estimate

Fixed Cost	Cost (PKR)
Administration expense	10,740,000
Administration benefits expense	1,074,000
Building rental expense	4,860,000
Office expenses (stationery, entertainment, janitorial services, etc.)	537,000
Insurance expense	586,883
Depreciation expense	9,627,495
Amortization of pre-operating costs	244,251
Total	**27,669,628**

9.10. Human Resource Requirement

For the 1st year of operations, the HPDC manufacturing unit shall require the workforce at a salary cost as projected in Table 28.

Table 28: Human Resource Requirement

Designation	No. of Persons	Average Monthly Salary (PKR)	Total Salary (PKR)
CEO	1	150,000	1,800,000
Admin and Accounts Officer	1	50,000	600,000
Accounts Assistant	1	35,000	420,000
Procurement Officer	2	50,000	1,200,000
Quality Controller	2	50,000	1,200,000
Sales and Marketing Officer	2	60,000	1,440,000
Production department			
Production Manager	2	100,000	2,400,000
Mechanical Foreman	2	60,000	1,440,000
Electrician	2	35,000	840,000
Mechanic	2	35,000	840,000
Production Supervisor	2	70,000	1,680,000
HPDC Machine Operator	2	60,000	1,440,000
HPDC Machine Operator Helper	4	35,000	1,680,000
Furnace Operator	2	60,000	1,440,000
Furnace Helper	2	35,000	840,000
Lathe Machine Operator	4	40,000	1,920,000
Lathe Machine Helper	4	30,000	1,440,000
Unskilled labor-Assembling	4	30,000	1,440,000
Unskilled labor-packing	4	30,000	1,440,000
Store In charge	4	40,000	1,920,000
Security Guard	4	30,000	1,440,000
Office Boy	2	30,000	720,000
Total	**55**		**29,580,000**

10. CONTACT DETAILS

Details of suppliers of Machinery and Equipment are provided in Table 29.

Table 29: Contact Details of Suppliers

Supplier Name	Product	Contact Details	Email	Website
Zitai Precision Machinery Co.,Ltd (China)	Machinery	886-4-2561-1858		https://www.zitai.com/en/
Guangdong Yizumi (China)	Machinery	86-757-2926 2215	imm@yizumi.com	https://www.yizumi.com/en
Bühler Group (Lahore)	Machinery	+92 423 529 8701-7	adnan.hafeez@buhlergroup.com	https://www.buhlergroup.com
Jinan Hyded Thermal Tech Co., Ltd (China)	Furnace	+86 18660151258	info@hydeb.com	www.hydeb.com
AL-Noor Machines	Machinery	0321 8481392	info@alnoormachinery.com	https://www.alnoormachinery.com/
Hilti Pakistan (Lahore)	Machinery	(042)111 527 527	info@jaffer.com	https://www.hilti.pk/
Arsalan Chaudhary Enterprises (Lahore)	Aluminum	0332-4375857	arsalance@hotmail.com	https://arsalance.com/
Lucky Metals Enterprises (Karachi)	Aluminum	+92-21-2723536	m.naveed@lme.com.pk	https://www.lme.com.pk
Abdul Sattar Sons (Multan)	Aluminum	+92 336 169 0090	info@abdulsattarsons.net	http://www.abdulsattarsons.net/
EO Aluminum (China)	Aluminum	+8613042442971	info@eoexport.com	https://www.eoaluminum.com/

11. USEFUL LINKS

Table 30: 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
Pakistan Association of Automotive Parts & Accessories Manufacturers (PAAPAM)	https://www.paapam.com/
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/

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
Total Revenue	246,758,400	299,391,967	360,250,188	430,468,954	511,330,892	604,283,543	710,959,731	833,200,370	973,080,008	1,073,307,249
Cost of sales										
Material Cost (Aluminium)	131,327,179	159,339,267	191,728,594	229,099,692	272,135,188	321,605,478	378,379,565	443,437,201	517,882,482	571,224,378
Other Components Cost	42,933,240	52,090,900	62,679,559	74,896,850	88,965,935	105,138,672	123,699,152	144,967,675	169,305,189	186,743,623
Packing Cost	928,519	1,114,701	1,328,338	1,573,223	1,853,637	2,174,413	2,541,001	2,959,548	3,436,977	3,771,559
Consumables	205,000	226,115	249,405	275,094	303,428	334,681	369,153	407,176	449,115	495,374
Direct Electricity	1,435,403	1,874,048	2,406,464	3,047,369	3,813,431	4,723,498	5,798,860	7,063,533	8,544,577	9,219,599
Direct Labour	18,840,000	20,667,480	22,672,226	24,871,431	27,283,960	29,930,504	32,833,763	36,018,638	39,512,446	43,345,154
Gas Expense	2,298,226	2,788,437	3,355,250	4,009,245	4,762,366	5,628,096	6,621,642	7,760,151	9,062,943	9,996,427
Machinery repair and maintenance	1,433,750	1,581,426	1,744,313	1,923,977	2,122,147	2,340,728	2,581,823	2,847,751	3,141,069	3,464,600
Vehicle running and maintenance cost	1,131,900	1,248,486	1,377,080	1,518,919	1,675,368	1,847,930	2,038,267	2,248,209	2,479,774	2,735,191
Total cost of sales	200,533,218	240,930,860	287,541,229	341,215,800	402,915,460	473,724,001	554,863,228	647,709,882	753,814,574	830,995,904
Gross Profit	46,225,182	58,461,107	72,708,960	89,253,154	108,415,431	130,559,542	156,096,503	185,490,488	219,265,435	242,311,345
General administration & selling expenses										
Administration expense	10,740,000	11,781,780	12,924,613	14,178,300	15,553,595	17,062,294	18,717,336	20,532,918	22,524,611	24,709,498
Administration benefits expense	1,074,000	1,178,178	1,292,461	1,417,830	1,555,360	1,706,229	1,871,734	2,053,292	2,252,461	2,470,950
Building rental expense	4,860,000	5,346,000	5,880,600	6,468,660	7,115,526	7,827,079	8,609,786	9,470,765	10,417,842	11,459,626
Indirect Electricity	1,233,059	1,330,470	1,435,578	1,548,988	1,671,358	1,803,396	1,945,864	2,099,587	2,265,454	2,444,425
Communications expense (phone, internet etc.)	429,600	471,271	516,985	567,132	622,144	682,492	748,693	821,317	900,984	988,380
Office expenses (stationery, entertainment, janitorial services, etc.)	537,000	589,089	646,231	708,915	777,680	853,115	935,867	1,026,646	1,126,231	1,235,475
Promotional expense	1,233,792	1,496,960	1,801,251	2,152,345	2,556,654	3,021,418	3,554,799	4,166,002	4,865,400	5,366,536
Insurance expense	586,883	498,850	410,818	322,785	234,753	146,721	58,688	1,117,234	949,649	782,064
Depreciation expense	9,627,495	9,627,495	9,603,995	9,679,565	9,679,565	9,648,626	6,629,051	18,180,501	18,139,769	18,270,751
Amortization of pre-operating costs	244,251	244,251	244,251	244,251	244,251	-	-	-	-	-
Bad debt expense	616,896	748,480	900,625	1,076,172	1,278,327	1,510,709	1,777,399	2,083,001	2,432,700	2,683,268
Miscellaneous expense 1										
Subtotal	31,182,975	33,312,824	35,657,407	38,364,943	41,289,213	44,262,077	44,849,218	61,551,263	65,875,102	70,410,974
Operating Income	15,042,207	25,148,283	37,051,553	50,888,211	67,126,218	86,297,465	111,247,285	123,939,226	153,390,333	171,900,372
Other income (interest on cash)	-	-	-	-	-	-	-	-	-	-
Income from Scrap	2,420,863	2,937,233	3,534,293	4,223,185	5,016,494	5,928,421	6,974,985	8,174,247	9,546,559	10,529,854
Gain / (loss) on sale of machinery & equipment	-	-	-	-	-	-	14,337,500	-	-	
Gain / (loss) on sale of office equipment	-	-	-	-	-	-	652,250	-	-	
Gain / (loss) on sale of office vehicles	-	-	-	-	-	-	133,825	-	-	
Earnings Before Interest & Taxes -	17,463,070	28,085,516	40,585,846	55,111,396	72,142,713	92,225,886	133,345,846	132,113,473	162,936,892	182,430,226
Earnings Before Tax	17,463,070	28,085,516	40,585,846	55,111,396	72,142,713	92,225,886	133,345,846	132,113,473	162,936,892	182,430,226
Tax	3,084,480	3,742,400	4,503,127	5,380,862	6,391,636	7,553,544	8,886,997	10,415,005	12,163,500	13,416,341
NET PROFIT/(LOSS) AFTER TAX	**14,378,590**	**24,343,116**	**36,082,718**	**49,730,534**	**65,751,077**	**84,672,342**	**124,458,849**	**121,698,468**	**150,773,392**	**169,013,886**

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	1,000,000	6,114,549	21,542,844	34,853,098	49,129,657	63,642,409	77,288,667	115,517,339	237,589,098	387,358,009	643,738,088
Accounts receivable		20,281,512	22,444,536	27,108,582	32,495,307	38,704,103	45,847,169	54,051,093	63,458,634	74,230,700	84,098,106
Finished goods inventory		-	-	-	-	-	-	-	-	-	-
Spares Inventory	119,479	144,437	174,608	211,082	255,174	308,477	372,914	450,811	544,980	658,820	-
Raw material inventory	7,299,539	9,768,208	12,963,805	17,085,421	22,384,289	29,177,035	37,862,218	48,940,966	63,042,718	76,696,383	-
Pre-paid building rent	-	445,500	490,050	539,055	592,961	652,257	717,482	789,230	868,153	954,969	-
Pre-paid insurance	586,883	498,850	410,818	322,785	234,753	146,721	58,688	1,117,234	949,649	782,064	-
Total Current Assets	9,005,901	37,253,056	58,026,660	80,120,022	105,092,141	132,631,001	162,147,138	220,866,674	366,453,233	540,680,945	727,836,194
Fixed assets											
Land	-	-	-	-	-	-	-	-	-	-	-
Building Rennovation	1,058,000	952,200	846,400	740,600	634,800	529,000	423,200	317,400	211,600	105,800	-
Machinery & equipment	57,350,000	48,747,500	40,145,000	31,542,500	22,940,000	14,337,500	5,735,000	108,945,000	92,603,250	76,261,500	59,919,750
Allied Equipment	470,000	305,500	141,000	618,770	402,201	185,631	814,631	529,510	244,389	1,072,489	697,118
Furniture & fixtures	1,887,000	1,603,950	1,320,900	1,037,850	754,800	471,750	188,700	3,584,642	3,046,946	2,509,249	1,971,553
Office vehicles	535,300	455,005	374,710	294,415	214,120	133,825	53,530	1,111,369	944,663	777,958	611,253
Office equipment	2,609,000	2,217,650	1,826,300	1,434,950	1,043,600	652,250	260,900	4,956,190	4,212,762	3,469,333	2,725,905
Security Against Building	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000
Total Fixed Assets	65,124,300	55,496,805	45,869,310	36,884,085	27,204,521	17,524,956	8,690,961	120,659,111	102,478,610	85,411,329	67,140,578
Intangible assets											
Pre-operation costs	1,221,255	977,004	732,753	488,502	244,251	-	-	-	-	-	-
Legal, licensing, & training costs	-	-	-	-	-	-	-	-	-	-	-
Total Intangible Assets	1,221,255	977,004	732,753	488,502	244,251	-	-	-	-	-	-
TOTAL ASSETS	**75,351,456**	**93,726,865**	**104,628,723**	**117,492,609**	**132,540,913**	**150,155,957**	**170,838,099**	**341,525,785**	**468,931,843**	**626,092,274**	**794,976,772**
Liabilities & Shareholders' Equity											
Current liabilities											
Accounts payable		11,186,114	13,511,062	16,216,692	19,361,959	23,015,214	27,255,829	32,176,132	37,883,723	44,270,762	44,141,375
Other liabilities											
Total Current Liabilities	-	11,186,114	13,511,062	16,216,692	19,361,959	23,015,214	27,255,829	32,176,132	37,883,723	44,270,762	44,141,375
Other liabilities											
Total Long Term Liabilities	-	-	-	-	-	-	-	-	-	-	-
Shareholders' equity											
Paid-up capital	75,351,456	75,351,456	75,351,456	75,351,456	75,351,456	75,351,456	75,351,456	116,659,988	116,659,988	116,659,988	116,659,988
Retained earnings		7,189,295	15,766,206	25,924,462	37,827,498	51,789,287	68,230,815	192,689,664	314,388,132	465,161,523	634,175,409
Total Equity	75,351,456	82,540,751	91,117,661	101,275,918	113,178,954	127,140,743	143,582,270	309,349,652	431,048,120	581,821,512	750,835,398
TOTAL CAPITAL AND LIABILITIES	**75,351,456**	**93,726,865**	**104,628,723**	**117,492,609**	**132,540,913**	**150,155,957**	**170,838,099**	**341,525,785**	**468,931,843**	**626,092,274**	**794,976,772**

12.3. Cash Flow Statement

Calculations **SMEDA**

Cash Flow Statement

	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		14,378,590	24,343,116	36,082,718	49,730,534	65,751,077	84,672,342	124,458,849	121,698,468	150,773,392	169,013,886
Add: depreciation expense		9,627,495	9,627,495	9,603,995	9,679,565	9,679,565	9,648,626	6,629,051	18,180,501	18,139,769	18,270,751
amortization of pre-operating costs		244,251	244,251	244,251	244,251	244,251	-	-	-	-	-
Accounts receivable		(20,281,512)	(2,163,023)	(4,664,046)	(5,386,726)	(6,208,796)	(7,143,065)	(8,203,925)	(9,407,541)	(10,772,066)	(9,867,406)
Finished goods inventory		-	-	-	-	-	-	-	-	-	-
Spares inventory	(119,479)	(24,958)	(30,171)	(36,474)	(44,092)	(53,303)	(64,437)	(77,897)	(94,169)	(113,840)	658,820
Raw material inventory	(7,299,539)	(2,468,669)	(3,195,597)	(4,121,616)	(5,298,868)	(6,792,746)	(8,685,182)	(11,078,748)	(14,101,752)	(13,653,664)	76,696,383
Pre-paid building rent	-	(445,500)	(44,550)	(49,005)	(53,906)	(59,296)	(65,226)	(71,748)	(78,923)	(86,815)	954,969
Advance insurance premium	(586,883)	88,032	88,032	88,032	88,032	88,032	88,032	(1,058,546)	167,585	167,585	782,064
Accounts payable		11,186,114	2,324,948	2,705,630	3,145,267	3,653,255	4,240,615	4,920,303	5,707,590	6,387,040	(129,388)
Other liabilities		-	-	-	-	-	-	-	-	-	-
Cash provided by operations	(8,005,901)	12,303,844	31,194,501	39,853,486	52,104,058	66,302,039	82,691,705	115,517,339	122,071,759	150,841,400	256,380,079
Financing activities											
Issuance of shares	75,351,456	-	-	-	-	-	-	41,308,533	-	-	-
Purchase of (treasury) shares											
Cash provided by / (used for) financing activities	75,351,456	-	-	-	-	-	-	41,308,533	-	-	-
Investing activities											
Capital expenditure	(66,345,555)	-	-	(618,770)	-	-	(814,631)	(118,597,200)	-	(1,072,489)	-
Cash (used for) / provided by investing activities	(66,345,555)	-	-	(618,770)	-	-	(814,631)	(118,597,200)	-	(1,072,489)	-
NET CASH	1,000,000	12,303,844	31,194,501	39,234,716	52,104,058	66,302,039	81,877,073	38,228,671	122,071,759	149,768,911	256,380,079

13. KEY ASSUMPTIONS

13.1. Operating Cost Assumptions

Table 31: Operating Cost Assumptions

Description	Details
Inflation rate	10.3%
Electricity growth rate	7.9%
Machinery maintenance cost (% of machinery cost)	3%
Communications expense (% of administration expense)	4%
Promotional expense (% of revenue)	0.50%
Machinery & equipment insurance rate (% of machinery cost)	1.0%
Office equipment price growth rate	9.6%
Office vehicles price growth rate	11%

13.2. Revenue Assumptions

Table 32: Revenue Assumptions

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

13.3. Financial Assumptions

Table 33: Financial Assumptions

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

13.4. Cash Flow Assumptions

Table 34 Cash Flow Assumptions

Description	Days
Account Receivable Days	30
Account Payable Days	20

13.5. Inventory Days Assumptions

Table 35: Inventory Days Assumptions

Description	Details
Raw material Inventory Days	15

13.6. Debt Related Assumptions

Table 36: Debt Related Assumptions

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

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