

MANUFACTURING OF SERVO MOTORS

1. INTRODUCTION:

Servo motors (or servos) are self-contained electric devices that rotate or push parts of a machine with great precision. Servos are found in many places: from toys to home electronics to cars and air-planes. If you have a radio-controlled model car, air-plane, or helicopter, you are using at least a few servos. In a model car or aircraft, servos move levers back and forth to control steering or adjust wing surfaces. By rotating a shaft connected to the engine throttle, a servo regulates the speed of a fuel-powered car or aircraft. Servos also appear behind the scenes in devices we use every day. Electronic devices such as DVD and Blue-ray DiscTM players use servos to extend or retract the disc trays. In 21st-century automobiles, servos manage the car's speed: The gas pedal, similar to the volume control on a radio, sends an electrical signal that tells the car's computer how far down it is pressed. The car's computer calculates that information and other data from other sensors and sends a signal to the servo attached to the throttle to adjust the engine speed. Commercial aircraft use servos and a related hydraulic technology to push and pull just about everything in the plane.

The simplicity of a servo is among the features that make them so reliable. The heart of a servo is a small direct current (DC) motor, similar to what you might find in an inexpensive toy. These motors run on electricity from a battery and spin at high RPM (rotations per minute) but put out very low torque (a twisting force used to do work— you apply torque when you open a jar). An arrangement of gears takes the high speed of the motor and slows it down while at the same time increasing the torque. (Basic law of physics: $\text{work} = \text{force} \times \text{distance}$.) A tiny electric motor does not have much torque, but it can spin really fast (small force, big distance). The gear design inside the servo case converts the output to a much slower rotation speed but with more torque (big force, little distance). The amount of actual work is the same, just more useful. Gears in an inexpensive servo motor are generally made

of plastic to keep it lighter and less costly (see Figure 3 below). On a servo designed to provide more torque for heavier work, the gears are made of metal (see Figure 4 below) and are harder to damage.

With a small DC motor, you apply power from a battery, and the motor spins. Unlike a simple DC motor, however, a servos spinning motor shaft is slowed way down with gears. A positional sensor on the final gear is connected to a small circuit board (see Figure 5 below). The sensor tells this circuit board how far the servo output shaft has rotated. The electronic input signal from the computer or the radio in a remote-controlled vehicle also feeds into that circuit board. The electronics on the circuit board decode the signals to determine how far the user wants the servo to rotate. It then compares the desired position to the actual position and decides which direction to rotate the shaft so it gets to the desired position.

2. PRODUCT & ITS APPLICATION:

Types of servo motors: Servos come in many sizes and in three basic types: positional rotation, continuous rotation, and linear.

Positional rotation servo: This is the most common type of servo motor. The output shaft rotates in about half of a circle, or 180 degrees. It has physical stops placed in the gear mechanism to prevent turning beyond these limits to protect the rotational sensor. These common servos are found in radio-controlled cars and water- and aircraft, toys, robots, and many other applications.

Continuous rotation servo: This is quite similar to the common positional rotation servo motor, except it can turn in either direction indefinitely. The control signal, rather than setting the static position of the servo, is interpreted as the direction and speed of rotation. The range of possible commands causes the servo to rotate clockwise or counterclockwise as desired, at varying speed, depending on the command signal. You might use a servo of this type on a radar dish if you mounted one on a robot. Or you could use one as a drive motor on a mobile robot.

Linear servo: This is also like the positional rotation servo motor described above, but with additional gears (usually a rack and pinion mechanism) to change the output from circular to back-and-forth. These servos are not easy to find, but you can sometimes find them at hobby stores where they are used as actuators in larger model air-planes.

3. DESIRED QUALIFICATIONS FOR PROMOTER:

Graduate in any discipline, preferably science.

4. INDUSTRY LOOK OUT AND TRENDS

Servo motors are high performance electric motors having characteristics such as controlling the movement of machines. In addition, servo motors offer easy installation and no maintenance cost. Increasing electricity prices and stringent electricity utilization standards are driving the demand for energy efficient motors globally. The market of servo drives and motors is expected to grow at a slower pace in North America and Europe region. The demand for servo drives and motors is expected to rise due to the replacement of outdated low efficient electric motors with highly efficient servo drives and motors. In addition, the strict energy consumption regulations and environment protection acts as the key factors that are driving the servo drives and motors market globally.

The growth of servo drives and motors market is primarily attributed to positive economic outlook and growing manufacturing industries in India, China, South-Korea, Indonesia and several other countries in Asia-Pacific region. The increasing demand for energy efficient motors causes the shift from standard energy efficient electric motors to premium energy efficiency motors. This shift in trend is directly contributing to revenue growth of servo drives and motors manufacturers.

This market research study analyzes the servo drives and motors market on a global level, and provides estimates in terms of revenue (USD billion) from 2014 to 2020. The report identifies the drivers and restraints affecting the market and analyzes their impact over the

forecast period. In addition, it identifies the significant opportunities for market growth in the coming years.

The report segments the market on the basis of geography as North America, Europe, Asia Pacific (APAC), and Rest of the World (RoW), and these have been estimated in terms of revenue (USD billion). Moreover, the report segments the market based on types as servo drives and servo motors. The market has been further segmented based on different types of servo drives such as AC servo drives, DC servo drives and adjustable speed. Servo motors are further segmented into AC servo motors, DC brushless, brushed DC and linear servo motors. Furthermore, the market is segmented on the basis of application which includes automotive, semiconductor and electronics, material handling, food processing, healthcare and others. Among all the application segments, automotive segment holds the largest market share at present in the servo drives and motors market. All these segments have also been estimated on the basis of geography in terms of revenue (USD billion).

Asia Pacific represents the largest market for servo drives and motors. In 2014, Asia Pacific accounted for more than 40% revenue share in the global servo drives and motors market. The region is expected to be the fastest growing region due to significant growth in GDP of countries such as India, South Korea, China, Singapore, Taiwan and several others. In addition, positive growth prospects in GDP of these countries will help the region to remain market leader in servo drives and motors in coming few years.

5. MARKET POTENTIAL AND MARKETING ISSUES, IF ANY:

Servo motors and drives are used for automation in industrial processes has resulted in high throughput, less cost, low errors and less man-power requirement. Globally, development of efficient and advance automation technology, rise in adoption of energy-efficient international standards, growing ease of use and integration of motion control components in motors and drives, flourishing automotive industry, and advantages of servo motors and drives such as, high accuracy and speed, light weight machines, reduced size, increase in speed and higher torque are the prime growth drivers of global servo motors and drives market. In addition, increase in adoption of servo motors and drives for application in newer

industrial vertical, and emerging economies such as China, India and others, will create new opportunities for global servo motors and drives market. However, volatile prices and availability of raw materials, availability of substitute motors, and complex manufacturing process are the key restraint for global servo motors and drives market. Geographically Asia Pacific dominated global servo motors and drives market, followed by North America. Asia Pacific is projected to have fastest growth, owing to rapidly increasing auto-mobile industry, rise in industrial sector, and growing investment in the manufacturing industry in developing nations such as China, and India in this region. Among all the applications, automotive & transport industry has the highest market share in global servo motors and drives market due to spur in automotive industry, innovation, and technical advancement in automotive industry. The medium voltage servo motors and drives is the market leader among all voltage groups of servo motors and drives, owing to its rising demand from industries such as metal, mining, power generation, and water & waste water treatment. Presently, 108 known companies producing servos worldwide

They are made classification as – Analog / Digital, Different operating voltages, plastic / metal body and gears, fast / slow, etc. in the Price range of \$1 to \$350.

6. RAW MATERIAL REQUIREMENTS:

The Basic raw materials required for this project are Metal Gears, Gear material: Stainless steel & Brass, mainly Smallest Gear we need Size is very small, Low module, $m=0.25$, Small whole size. The others are PCB, PCB Size: 38 x 17.5 x 1.6 mm Box material: Aluminum, 3D - Print for Primary aim to check dimensional compliances between different parts. as • Shrinkage • Brittle • Tolerances between different moving parts • Decided on metal covers and gears 3D-printed plastic prototype, PCB part procurement, PCB CAD design, Metal gear CAD design, Metal box CAD design, PCB – multi-layered – glass fiber and Chip level components to be procured

7. MANUFACTURING PROCESS:

The manufacturing require two major divisions Management, 1.Electronics, 2.Mechanical.The main steps are assembly, design, (Mechanical & Electronics) and Mechanical Component

manufacture. The other step is testing, • Shrinkage • Brittle• Tolerances between different moving parts • Decided on metal covers and gears.

The process requires high skill, high precision and detailed designing. The each division will work under sharp inspection of highly qualified persons.

8. MANPOWER REQUIREMENT:

The enterprise requires 15 employees as detailed below:

Sr. No.	Designation of Employees	Monthly Salary ₹	Number of employees required				
			Year-1	Year-2	Year-3	Year-4	Year-5
1	Chemist @ 12000	36000.00	3	3	3	4	4
2	Skilled workers @ 8000	24000.00	3	3	3	5	5
1	Manager @ 15000	30000.00	2	2	2	3	3
2	Accounts/Sales Asst @12500	25000.00	2	2	2	2	2
3	Office Boy @ 9000	18000.00	1	1	1	1	1
	Total	133000.00	11	11	11	15	15

9. IMPLEMENTATION SCHEDULE:

The project can be implemented in 4 months' time as detailed below:

Sr. No.	Activity	Time Required (in months)
1	Acquisition of premises	1.00
2	Construction (if applicable)	1.00
3	Procurement & installation of Plant & Machinery	2.00
4	Arrangement of Finance	2.00
5	Recruitment of required manpower	1.00
	Total time required <i>(some activities shall run concurrently)</i>	4.00

10. COST OF PROJECT:

The project shall cost ₹ 120.50 lacs as detailed below:

Sr. No.	Particulars	₹ in Lacs
1	Land	10.00
2	Building	35.00
3	Plant & Machinery	25.00
4	Furniture, Electrical Installations	3.00
5	Other Assets including Preliminary / Pre-operative expenses	2.50
6	Working Capital	45.00
	Total	120.50

11. Means of Finance :

The proposed funding pattern is as under:

Sr. No.	Particulars	₹ in Lacs
1	Promoter's contribution	30.13
2	Bank Finance	90.38
	Total	120.50

12. WORKING CAPITAL CALCULATION:

The project requires working capital of ₹ 45.00 lacs as detailed below:

Sr. No.	Particulars	Gross Amt	Margin %	Margin Amt	Bank Finance
1	Inventories	22.50	0.25	5.63	16.88
2	Receivables	11.25	0.25	2.81	8.44
3	Overheads	11.25	100%	11.25	0.00
4	Creditors	-		0.00	0.00
	Total	45.00		19.69	25.31

13. LIST OF MACHINERY REQUIRED:

Sr. No.	Particulars	UOM	Qty	Rate (₹)	Value (₹ in
	Plant & Machinery / equipments				
a)	Main Machinery				
i.	Gear manufacturing division	NOS.	1	700000	7.00
ii.	Electronics division	Nos	1	600000	6.00
iii.	Metal Division	Nos	1	300000	3.00
IV	Testing Division	Nos	1	500000	5.00
V	Installation, erection electr.			200,000	2.00
VI	taxes and transportation			200000	2.00
	<i>sub-total Plant & Machinery</i>				25.00
	Furniture / Electrical installations				
a)	Office furniture	LS	1	200000	2.00
b)	Stores Almirah	LS	1	0	1.00
c)	Computer & Printer	L. S.	1	200000	2.00
	<i>sub total</i>				3.00
	Other Assets				
a)	preliminary and preoperative				2.50
	<i>sub-total Other Assets</i>				2.50
	Total				30.50

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of machines and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

1. Hifine Machine

5, New India Estate, Inside Relief Hotel,
Sanand Char Rasta, Sarkhej, Ahmedabad-382210, Gujarat
Phone: 079 26891274, 079 26890274

2. Heena Machine Product

No. 1, Samrat Industrial Area,
Near Ban Labs, Rajkot - 360004, Gujarat, India

3. Sagar Engineering Works

A-129, Road No. 9 D,
V. K. I. Area, Jaipur - 302013,
Rajasthan, India
Phone: +91-9829024358, +91-141-4064876

4. Meter Centre

No. 1778/6, Ground Floor, Gandhi Main Road,
Near HDFC Bank, Ahmedabad, Gujarat 380001
Phone: 098257 01297

5. Pulsar Electronics Private Limited

No. 127/128, Sonal Link Industrial Estate, No. 2,
Link Road Opposite Movie Time Cinema,
Malad West, Mumbai - 400064, Maharashtra, India
Phone: +91-7021000597,+91-9867024141

6. Cosmic Devices

No. 1702/307, Srinath Building, 3rd Floor Bhagirath Palace, Chandni Chowk, Delhi -
110006, India
Phone: +91-9810413218, +91-9313866166

14. PROFITABILITY CALCULATIONS:

Sr. No.	Particulars	UOM	Year-1	Year-2	Year-3	Year-4	Year-5
1	Capacity Utilization	%	60%	70%	80%	90%	100%
2	Sales	₹. In Lacs	135.00	157.50	180.00	202.50	225.00
3	Raw Materials & Other direct inputs	₹. In Lacs	102.42	119.49	136.56	153.63	170.70
4	Gross Margin	₹. In Lacs	32.58	38.01	43.44	48.87	54.30
5	Overheads except interest	₹. In Lacs	11.01	11.70	13.07	13.48	13.76
6	Interest@ 10 % on 2.20 lakhs	₹. In Lacs	9.04	9.04	6.03	4.52	3.62
7	Depreciation	₹. In Lacs	17.50	12.50	8.75	6.25	5.63
8	Net Profit before tax	₹. In Lacs	-4.97	4.78	15.59	24.62	31.30

The basis of profitability calculation:

The growth of selling capacity will be increased 10% per year. (This is assumed by various analysis and study; it can be increased according to the selling strategy.)

Energy Costs are considered at Rs 7 per Kwh and fuel cost is considered at Rs. 65 per liter. The depreciation of plant is taken at 10-12 % and Interest costs are taken at 14 -15 % depending on type of industry.

15. BREAKEVEN ANALYSIS:

The project shall reach cash break-even at 32.00 % of projected capacity as detailed below:

Sr. No.	Particulars	UOM	Value
1	Sales at full capacity	₹. In Lacs	225.00
2	Variable costs	₹. In Lacs	170.70
3	Fixed costs incl. interest	₹. In Lacs	17.38
4	BEP = $FC/(SR-VC) \times 100 =$	% of capacity	32.00%

16. STATUTORY / GOVERNMENT APPROVALS

As per the allocation of business rules under the Constitution, labour is in the concurrent list of subjects. It is dealt with by the MOLE at the Central and Departments of Labour under State Governments in respective States / UTs. The MOLE has enacted workplace safety and health statutes concerning workers in the manufacturing sector, mines, ports and docks and in construction sectors.

Further, other Ministries of the Government of India have also enacted certain statutes relating to safety aspects of substances, equipment, operations etc. Some of the statutes applicable in the manufacturing sector are discussed below:

The Manufacture, Storage and Import of Hazardous Electronic Rules (MSIHC), 1989

These MSIHC Rules are notified under the Environment (Protection) Act, 1986. These rules are aimed at regulating and handling of certain specified hazardous chemicals. The rules stipulate requirements regarding notification of site, identification of major hazards, taking necessary steps to control major accident, notification of major accident, preparation of safety report and on-site emergency plan; prevention and control of major accident, dissemination of information etc. These rules are notified by the Ministry of Environment and Forests (MOEF) but enforced by the Inspectorates of Factories of respective States / UTs in the manufacturing sector. Entrepreneur may contact State Pollution Control Board where ever it is applicable.

17. BACKWARD AND FORWARD INTEGRATIONS

Both forward and backward integration for any Electrical Industry are strategies to gain better control over the supply chain, reduce dependency on the suppliers and increase their competitiveness. The two strategies can help companies reduce their dependency on suppliers and increase their influence over the customers. The benefits of these strategies

can be big. Both impact the bottom line directly. Integration happens if a company moves upward or downward in its supply chain. Starting from the suppliers from whom the raw materials are obtained, the chain moves downstream towards the distributors and the retailers. If the suppliers' power is very high, it can create financial burdens for the company. Suppose the number of suppliers of a company is low, then the control in their hands would be low. The burden in that case will fall upon company's shoulders. Its expenditure on raw materials will be high.

18. TRAINING CENTERS AND COURSES

There is no such training required to start this business but, basic Electrical or IC bachelor's degree is plus point for enterpriser. Promoter may train their employees in such specialized institutions to grow up the business. There are few specialized Institutes provide degree certification in chemical Technology, few most famous and authenticate Institutions are as follows:

1. Department of Electrical LD College of engineering
No.120, Circular Road, University Area, Navrangpura,
Opposite Gujarat University, Ahmedabad, Gujarat 380015
2. MIT College of Engineering, Pune
Gate.No.140, Raj Baugh Educational Complex,
Pune Solapur Highway,
LoniKalbhor, Pune – 412201
Maharashtra, India

Udyamimitraportal (link : www.udyamimitra.in) can also be accessed for handholding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc.

Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates all over India.

Disclaimer:

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.