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INDUSTRIAL SUPPLY CHAIN SERIES



Position Sensors in Global Value Chains

Trade Dynamics, Production Landscape, and
India's Emerging Role

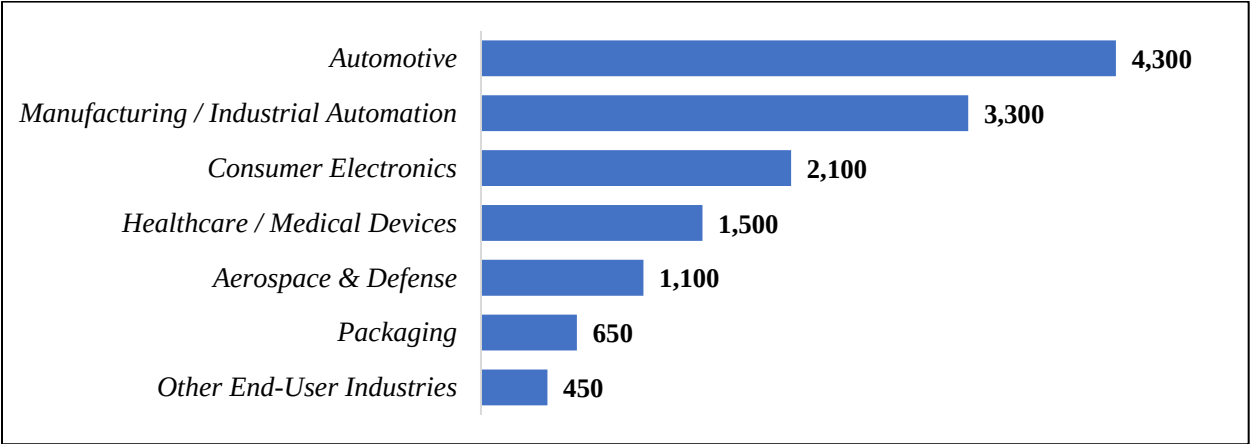
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1. Introduction and Context¹

Position sensors (PS) are foundational to modern industrial systems, enabling precise measurement of displacement, angle, and proximity that allows real-time feedback and control across automated processes. Major types include rotary and linear encoders, Hall-effect sensors, optical and capacitive sensors, potentiometers, and MEMS-based inertial sensors. These components serve as the building blocks of automation in automotive systems (ABS, steering, throttle, and EV motor control), industrial robotics and CNC machining, aerospace and medical devices, consumer electronics, and renewable-energy tracking systems. In other words, position sensors are critical inputs for the capital equipment and machinery that underpin some of the most technologically advanced and heavily traded sectors in the global economy today.

Figure-1: By End-User Industry, 2024 (USD MN)²



Source: Markets and Market report

The Position Sensor market's rapidly escalating importance is underscored by its projected growth in global demand from USD 13.25 billion in 2025 to USD 19.02 billion by 2030. This expansion represents a Compound Annual Growth Rate (CAGR) of 7.5%³, a rate that significantly outpaces the overall manufacturing sector⁴. This accelerated growth is driven by automation of production lines, transport electrification, AI- and IoT-enabled smart devices, and the miniaturization of sensing hardware, which are embedding sensors deeply across industrial value chains.

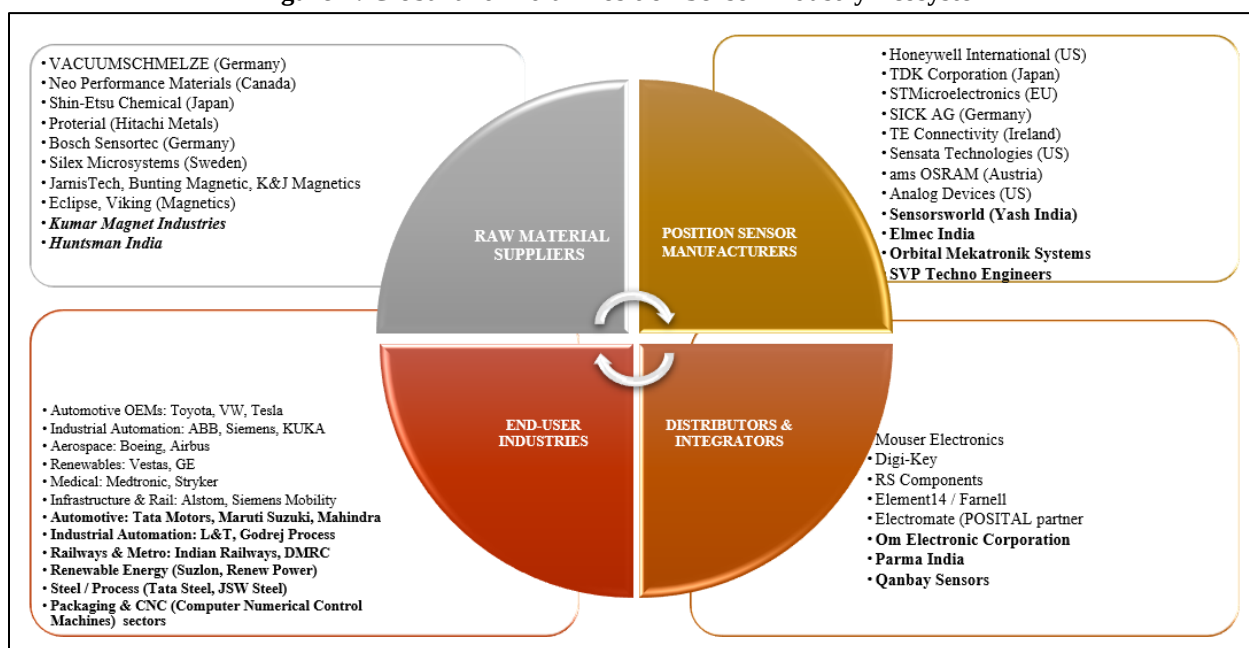
Despite robust demand, the industry contends with structural challenges, including high costs of ownership, thin profit margins, and limited standardization, which can stifle R&D and inhibit the scaling of smaller firms. Technologically, leadership remains concentrated in a few advanced economies, notably Germany, Japan, the United States, and Switzerland—where firms like SICK

¹ The Authors would like to acknowledge sincere efforts provided by Mr Anmol Gera and Ms Mallika Dutt.
² The automotive sector accounts for the largest market share (USD 4.3 billion), followed by manufacturing/industrial automation (USD 3.3 billion) and consumer electronics (USD 2.1 billion), indicating strong demand across automation and mobility-driven industries
³ <https://www.marketsandmarkets.com/Market-Reports/position-sensor-market-17719728.html>
⁴ [Global Manufacturing Market Share & Opportunities 2025-2032](#)

AG, TDK Corporation, and STMicroelectronics dominate high-value innovation and MEMS fabrication.

However, a strategic reorientation is underway within the global position sensor industry. While Europe continues to hold the largest revenue share⁵ of approximately 39%⁶, the industry's center of gravity is shifting eastward. The Asia-Pacific region, led by China, Japan, South Korea, and India, has become the epicenter for both future demand growth and expansion of production capacity. This geographic transition provides the strategic context for India's need to prioritize its own manufacturing ability of this critical component integral to modern engineering and electronics industry.

Figure-2: Global and Indian Position Sensor Industry Ecosystem⁷



Source: Authors adaptation from various industrial reports.

2. Global Trade Patterns in Position Sensors

Global trade in position sensors has expanded steadily over the past decade as an essential component in advanced in electronic industry and its role in enabling machine automation. The global import value grew from USD 63 billion in 2015 to USD 84 billion in 2024, achieving CAGR of 7.6%. This significantly outpaces the 4.3% growth of total merchandise imports, underscoring the increasing strategic importance of sensors as a backbone technology for modern industry. The

⁵ Latest available figures from 2023

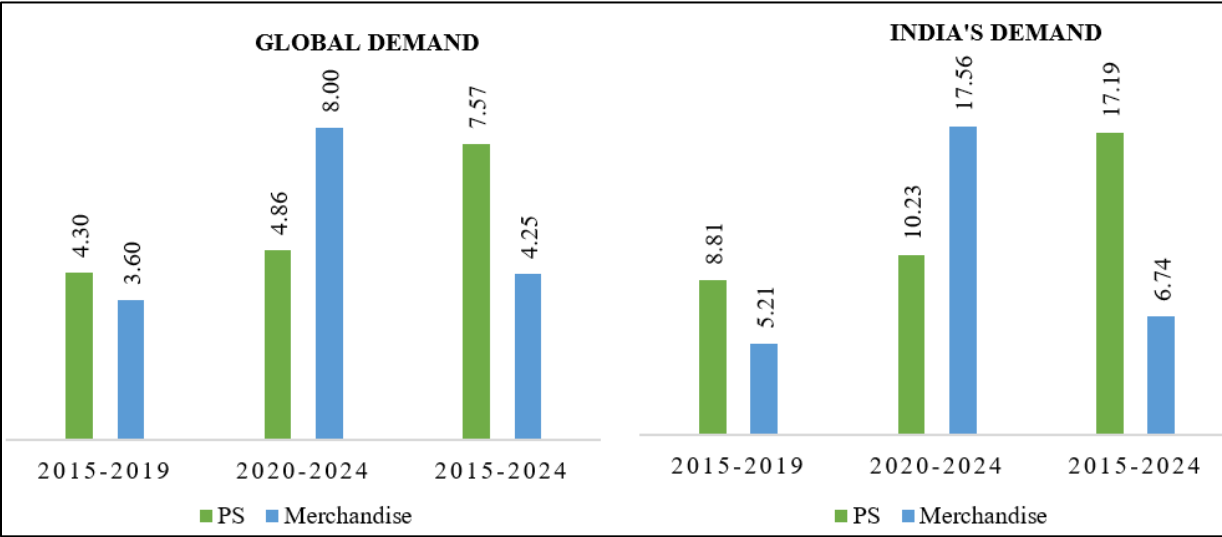
⁶ <https://www.grandviewresearch.com/industry-analysis/position-sensors-market>

⁷ Indian firms are shown in bold text. The circular flow denotes interlinkages across the value chain—from material sourcing and manufacturing to distribution and final industrial application—highlighting India's expanding yet still nascent presence in higher-value segments of the global position sensor value chain.

global trade landscape remains dominated by established technological hubs, with China, the United States, and Germany collectively accounting for the majority of position sensor trade flows.

India’s import trajectory has seen a sharp increase in the last decade. Position-sensor imports increased from USD 1.4 billion in 2015 to USD 2.6 billion in 2024, a CAGR of 17.2%—nearly three times India’s overall merchandise import growth of 6.7% (Figure 3). This surge in import demand signals rapid technology adoption in automation, electric vehicles, and smart electronics manufacturing, highlighting India’s deepening, yet import-dependent, integration into technology-intensive global value chains (GVCs).

Figure-3: Global vs India—Import Growth Rate (%) of PS and Merchandise (2015–2024)



Source: ITC TradeMap

A granular analysis of India's trade data reveals a pronounced structural dependency on imported position sensors. As detailed in Table 1, across all major product categories⁸, importers vastly outnumber exporters. For example, under the product–instruments for measuring quantities of heat, sound, or light⁹, there are 6,832 importers compared to only 3,008 exporters. This consistent pattern—where import declarations (Bills of Entry) far exceed export declarations (Shipping Bills)—highlights that India's role in the GVC is primarily that of a high-growth consumer, with a still-nascent domestic manufacturing and export capacity.

⁸ Categorized at the HS6 level of classification. Harmonized System (HS) is an international classification system developed by the WCO that assigns standardized six-digit codes to traded goods for customs and trade statistics.

⁹ HS 903180

Table-1: India's Importer Exporter Code (IEC) data and shipment records

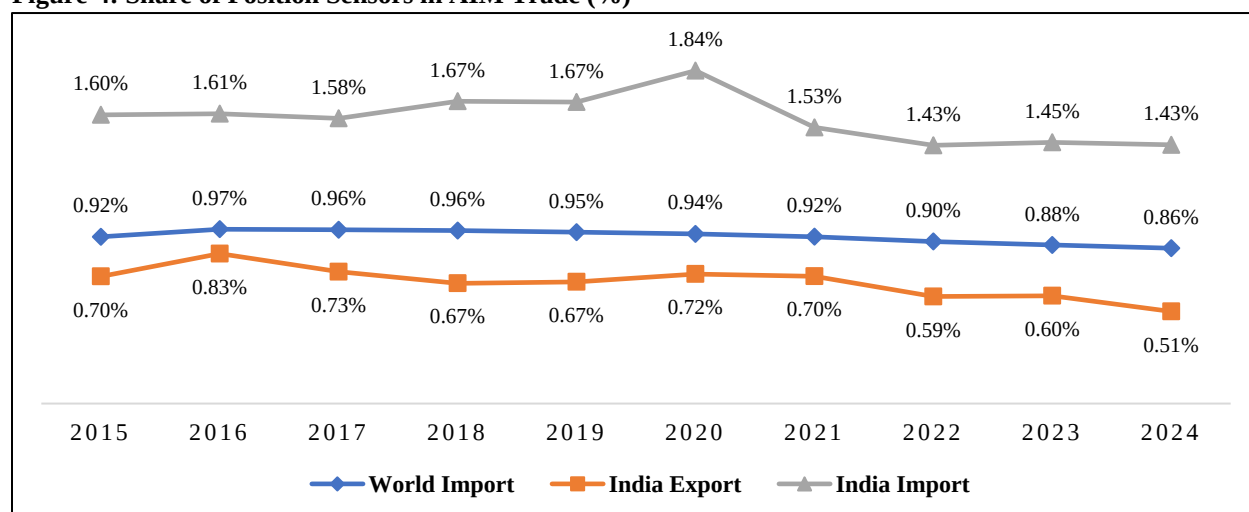
HS 6-digit Codes ¹⁰	Imports		Exports	
	BOE Count	IEC Count	SB Count	IEC Count
903180	59373	6832	16350	3008
903190	23239	3362	6163	1300
903289	33441	3048	11218	1949
903290	16443	1574	7320	1000
903149	4404	1184	1458	744

Source: DGCIS

2.1 Position Sensors within Advanced Industrial Manufacturing (AIM)

The criticality of this import dependency is magnified when examining the role of position sensors within AIM—sectors that rely heavily on precision measurement and automation systems.¹¹ As shown in Figure 4, position sensors have consistently accounted for a stable 1% of global AIM imports. While seemingly modest, this stable share represents a multi-billion-dollar, indispensable global market for a foundational component in high-tech manufacturing.

Figure-4: Share of Position Sensors in AIM Trade (%)



Source: ITC TradeMap

Notably, India's position-sensor imports, as a share of its own AIM imports, have consistently exceeded the global average. This indicates a heavy reliance on imported sensors to fuel its rapid expansion in automation, EVs, and electronics. This dependency is mirrored by a low and stagnant

¹⁰ Product description for each HS has been provided in Annex.

¹¹ It represents the technology-centric segment of industrial structure, serving as a proxy for sectors where PS act as foundational component enabling automation, precision control, and digital manufacturing capabilities. Considering HS- (84,85,86,87,88,89,90,91,93,95)

export share (0.5–0.8%), revealing limited domestic production depth and export capacity in this high-tech segment.

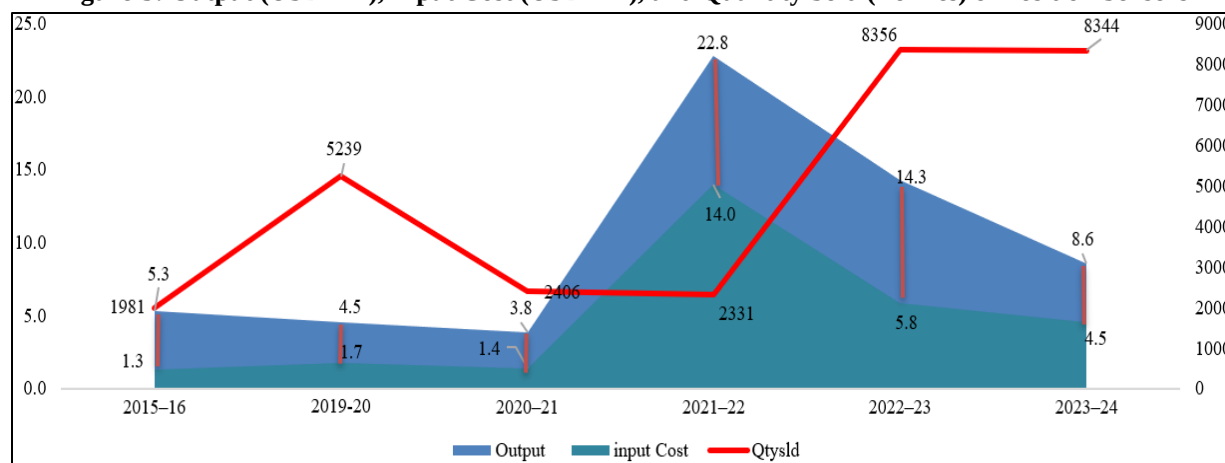
Overall, rising demand for position sensors—globally and in India—and their role as critical components in high-tech machinery and equipment present a strong case for developing domestic manufacturing scale in India and capturing more value within the sensor supply chain.

3. India's Production Landscape: Evidence from Annual Survey of Industries (ASI)

The persistent trade gap identified in Section 2 is a symptom of deeper structural issues within India's domestic production ecosystem. An analysis of ASI data reveals that PS is characterized by volatile growth and persistent efficiency challenges, which constrain its ability to compete with imports and scale exports.

A post-pandemic rebound saw output and productivity peak in 2021-22. However, these gains have since moderated significantly. The most recent data shows a critical squeeze: while production volumes have held steady approximately 8,300 units annually in 2022-23 and 2023-24 (figure 5), the average revenue per unit has collapsed by nearly 40%. This has severely compressed margins, revealing a sector that is volume-stable but increasingly price-pressured and struggling with profitability.

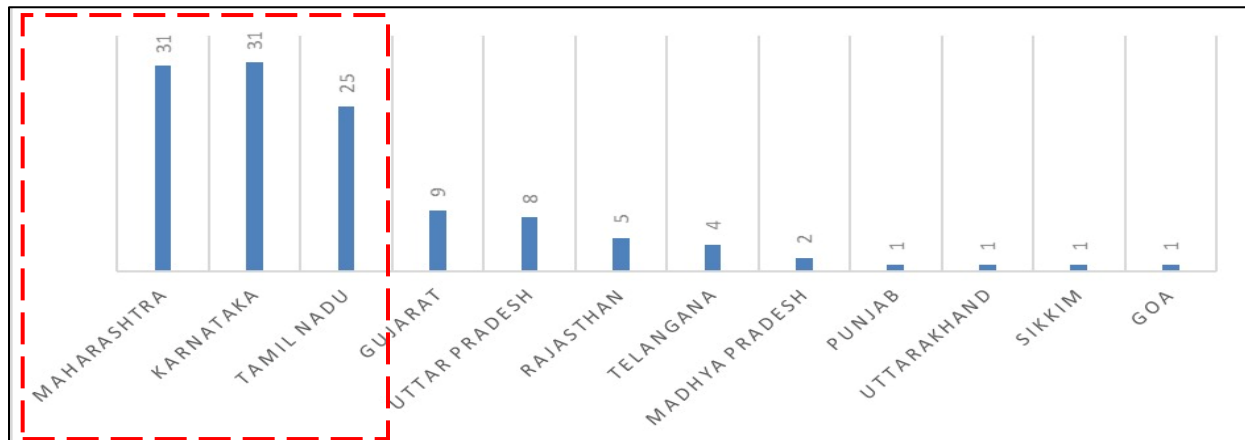
Figure-5: Output (USD Mn), Input Cost (USD Mn), and Quantity Sold (Tonnes) of Position Sensors



Source: Authors calculation based on ASI data

Spatially, the industry is highly concentrated. Approximately two-thirds of manufacturing units are located in Maharashtra, Karnataka, and Tamil Nadu (figure 6), aligning with established automotive and electronics clusters in the Pune-Nashik, Bengaluru, and Chennai-Coimbatore corridors. This geographic clustering underscores the sector's reliance on existing supply chains and skilled labour pools, while also highlighting the limited penetration into other industrial regions.

Figure-6: State-wise distribution of units manufacturing position sensors (2024)



Source: Authors calculation based on ASI data

4. India's Strategic Position in the Global Sensor Value Chain

Analysis of trade and production data confirms India's emergence as a major growth market for position sensors. Demand is exploding across multiple key industries, creating a perfect opportunity to build a local manufacturing base and move up the value chain.

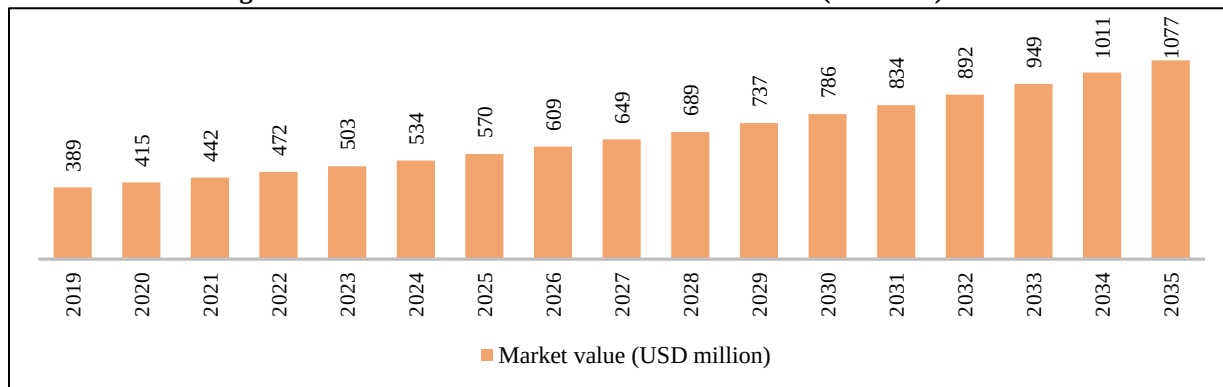
4.1 Automotive: The Primary Demand Driver

As the largest consumer of position sensors (40% of global demand), the automotive industry represents India's most significant opportunity. Driven by EV adoption, ADAS implementation, and smart mobility solutions, India's automotive sensor market is projected to grow from USD 534 million (2024) to USD 1.08 billion by 2035 (CAGR 6.6%) (figure 7). While currently dependent on imports¹², domestic manufacturers are progressively enhancing indigenous capabilities, supported by policy frameworks including FAME-II and production-linked incentives (PLI).¹³

¹² India imports sensors mainly from China, Germany, Japan, the U.S., and South Korea, firms such as Sensorsworld, Elmec, Orbital Mekatronik, and SVP Techno Engineers are strengthening indigenous capacity.

¹³ <https://www.marketresearchfuture.com/reports/india-automotive-position-sensors-market-58318>

Figure-7: India Automotive Position Sensors Market (USD MN)



Source: Markets Research Future report

4.2 Consumer Durables / Home Appliances: A High-Volume Growth Driver

Accounting for 12-14% of global position sensor demand (USD 1.6–1.8 billion in 2024), the consumer appliances sector represents a high-volume market segment poised to reach USD 2.5–2.8 billion by 2030. This growth is driven by the industry-wide transition from analog systems to motor-control automation and IoT-enabled devices requiring integrated sensing capabilities.

India's appliance market, valued at USD 25–30 billion in 2023, is projected to double to USD 55–60 billion by 2030, supported by production-linked incentives and expanding domestic OEM ecosystems. Major manufacturers including Voltas, Havells, Crompton, and Panasonic India are accelerating this transition through localization of BLDC motors and control modules, a development that is sharply increasing domestic position sensor demand. This sector consequently represents a sustained, high-volume driver for sensor integration within India's expanding electronics manufacturing value chain.

4.3 Healthcare / Medical Devices: A High-Value Niche

Healthcare represents 10–12 % of global PS demand ($\approx$ USD 1.5 billion in 2024¹⁴) and could reach USD 2.3–2.5 billion by 2030, reflecting growth in robotic surgery, diagnostics, and patient-monitoring systems.

India's medical-devices market, valued at USD 12 billion in 2023, projected to exceed USD 35–50 billion by 2032^{15,16}, is moving from low-complexity consumables toward electromechanical and embedded-electronics products. Policies such as the PLI for Medical Devices, MedTech Parks, and Medical Devices (Amendment) Rules 2020 are enabling local assembly of ventilators,

¹⁴ <https://www.grandviewresearch.com/industry-analysis/medical-sensors-market>

¹⁵ <https://pharmaceuticals.gov.in/schemes>

¹⁶ <https://www.investindia.gov.in/sector/medical-devices>

imaging, and diagnostic systems. Demand for miniaturized, non-contact PS will grow rapidly as India expands MedTech and automated healthcare infrastructure, making this a high-value niche for sensor manufacturing.

4.4 Aerospace and Defense: A Strategic Demand Driver

Accounting for 8-9% of global position sensor demand, the aerospace and defense sector represents a high-value, technology-intensive market. India's defense and space ecosystem, projected to grow from USD 27 billion (2023) to over USD 48 billion by 2032, is driving substantial demand for precision sensors through indigenization initiatives like Make in India for Defense and the Indian Space Policy 2023.

Major public enterprises (ISRO, HAL, BEL) and private defense contractors are localizing production of UAVs, satellites, and aircraft systems, creating strong demand for domestically manufactured position sensors. The sector's requirements for high-reliability components positions it as both a strategic imperative for self-reliance and a potential export opportunity.

5. Policy Implications and Way Forward

India's burgeoning demand for position sensors is met predominantly through imports, highlighting a critical gap between domestic consumption and production capability. A strategic pivot from consumer to creator is essential to build a robust ecosystem for local manufacturing, technological self-reliance, and export competitiveness.

While existing frameworks like the PLI and ECMS (Electronic Components and Semiconductor) schemes provide a foundation for localization, a more targeted approach is needed to address sector-specific gaps in MEMS fabrication, advanced magnetic materials, and calibration infrastructure. The following interventions are important for building a competitive domestic sensor industry:

- **Sensor-Specific PLI and Localization:** Launch a PLI-PS sub-scheme with higher incentives for precision and MEMS-based sensors, clear technology-transfer milestones, and progressive local value addition in MEMS dies, magnetics, and calibration materials. Promote joint ventures with global leaders for faster diffusion.
- **Testing & Standards Infrastructure:** Develop national calibration and reliability-testing hubs within electronics clusters to meet international standards and lower export-barrier costs.
- **Rationalizing Import Duties for Non-ECMS Components:** Permit zero-duty imports for all categories of components used in the manufacture of position sensors that are not currently covered under the ECMS scheme. It is recognized that existing FTAs with Japan,

the Republic of Korea, and ASEAN partners already provide zero or preferential duty access for several such components, and the forthcoming trade agreement with the European Union is expected to extend similar benefits.

- **Collaborative R&D and Design Innovation:** Form a National Sensor Innovation Consortium linking IITs, CSIR labs, MeitY CoEs, and industry to advance indigenous sensor design, firmware, and AI-based signal processing. Provide grant-matching for private R&D to build domestic IP.
- **Skill and Cluster Development:** Establish Mechatronics Skill Centers near major hubs (Pune–Nashik, Bengaluru, Chennai–Coimbatore) and develop cluster-linked supplier networks connecting SMEs with Tier-1 automotive and defense OEMs.
- **Strategic Integration into Global Value Chains:** Use trade partnerships and defense procurement to make India an Asia-Pacific hub for sensor design and assembly, ensuring stable demand and global market access.

Annex

1. Scope and Code Selection Rationale

This analysis focuses on the *core position sensor segment*, represented by HS codes **9031.49, 9031.80, 9031.90, 9032.89, and 9032.90**, which cover standalone measuring, checking, and automatic control instruments along with their key components. These codes most accurately reflect the **trade in position-sensing devices as independent products**—optical, inductive, magnetic, potentiometric, or capacitive sensors—and their integration into control instruments.

Extended codes such as **8542.39 / 8541.51–.59** (semiconductor sensor chips) or **8708.xx / 8714.xx** (automotive and vehicle parts embedding sensors) were intentionally excluded for three reasons:

1. **Functional ambiguity:** In integrated systems (e.g., throttle modules, robotic actuators), the sensor element's value is embedded and cannot be separately identified from the total assembly.
2. **Classification overlap:** Semiconductor and automotive parts codes aggregate multiple technologies beyond position sensing—making it impossible to isolate the sensor component through trade data alone.
3. **Analytical clarity:** Restricting to the 9031–9032 family allows a consistent comparison of global and domestic trade flows, production, and value addition specifically in the *precision instrumentation and control-device domain* (ISIC Rev.4 C2651–C2652 / NIC 26513–26529).

This approach aligns with international practice in trade-technology analysis, where studies distinguish between core technology codes (sensor devices and control instruments) and application or embedded codes (vehicles, robotics, or semiconductor assemblies). The findings presented here therefore represent the pure sensor and control-instrument market, forming the upstream foundation for sensor applications across automotive, industrial, and medical systems.

2. Definition of NPCMS codes

National Product Classification for Manufacturing Sector (NPCMS), 2011 has been constructed by CSO, IS Wing, Kolkata, based on Sections 0 to 4 of CPC, Ver. 2 that relate to products of the manufacturing sector.

- NPCMS, 2011 is a 7-digit classification and the structure is: 5-digit CPC Code + 2-digit Indian requirement.
- With 5 Sections, 40 Divisions, 190 Groups, 785 Classes and 1501 Sub-Classes = ultimately *7-digit products*.
- From ASI 2010-2011 onwards, the 7-digit code and its description as per NPCMS, 2011 will be used for collecting and recording of all input and output items in ASI schedule.

3. Concordance Issues

The mapping from HS to CPC to NCPMS used to identify position sensor manufacturers in the ASI database is an indicative concordance, as no direct one-to-one link exists between trade and industrial classifications. Position sensors are embedded within broader categories of measurement and control instruments, so the identified units represent an approximate rather than exhaustive count.

Table 1: Concordance from HS to NPCMS

HS Code	HS Description (Simplified)	NPCMS Code (2011 Revised)	NCPMS Description
903149	Other optical measuring instruments	4825300	<i>Instruments and apparatus for physical or chemical analysis, for measuring or checking quantities of heat, sound or light</i>
903180	Instruments for measuring quantities of heat, sound, or light	4825300	<i>Instruments and apparatus for physical or chemical analysis, for measuring or checking quantities of heat, sound or light</i>
903190	Parts and accessories of measuring instruments	4826399	<i>Parts and accessories of automatic regulating or control instruments (included in supply meters, etc.)</i>
903289	Automatic regulating or controlling instruments	4825200	<i>Instruments and apparatus for measuring or checking the flow, level, pressure or other variables of liquids or gases, except navigational or meteorological instruments; gas or liquid supply meters and automatic regulating instruments</i>
903290	Parts & accessories of automatic control instruments	4826399	<i>Parts and accessories of automatic regulating or control instruments (included in supply meters, etc.)</i>

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ABOUT THE CENTRE

About CRIT

India's Foreign Trade Policy (FTP) Statement 2015-20 suggested a need to create an institution at the global level that can provide a counter-narrative on key trade and investment issues from the perspective of developing countries like India. To fill this vacuum, a new institute, namely the Centre for Research on International Trade (CRIT), was set up in 2016. The vision and the objective of the CRIT were to significantly deepen existing research capabilities and widen them to encompass new and specialized areas amidst the growing complexity of the process of globalization and its spill-over effects in domestic policymaking. Secondly, enhancing the capacity of government officers and other stakeholders in India and other developing countries to deepen their understanding of trade and investment agreements.

About CWS

The Centre for WTO Studies which is a constituent Centre of CRIT, pre-dates the CRIT since it was created in 1999 to be a permanent repository of WTO negotiations-related knowledge and documentation. Over the years, the Centre has conducted a robust research program with a series of papers in all spheres of interest at the WTO. It has been regularly called upon by the Government of India to undertake research and provide independent analytical inputs to help it develop positions in its various trade negotiations, both at the WTO and other forums such as Free and Preferential Trade Agreements and Comprehensive Economic Cooperation Agreements. Additionally, the Centre has been actively interfacing with industry and Government units as well as other stakeholders through its Outreach and capacity-building programs by organizing seminars, workshops, subject-specific meetings, etc. The Centre thus also acts as a platform for consensus building between stakeholders and policymakers. Furthermore, the inputs of the Centre have been sought after by various international institutions to conduct training and studies.

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