Indian Automation Solutions Industry

23rd December 2024

Prepared for

Patil Automation Limited

Disclaimer

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Global Macroeconomic Landscape

Global & regional GDP growth scenario

The global economy, which grew by 3.3% in 2023, is expected to record a sluggish growth of 3.2% in 2024 before rising modestly to 3.3% in 2025. Between 2021-2022, global banks were carrying a historically high debt burden after COVID-19. Central banks took tight monetary measures to control inflation and spike in commodity prices. Russia's war with Ukraine further affected the global supply chains and inflated the prices of energy and other food items. These factors coupled with war-related economic sanctions impacted the economic activities in Europe. Any further escalation in the war may further affect the rebound of the economy in Europe.

While China, the largest manufacturing hub of world, was facing a crisis in the real estate sector and prices of properties were declining between 2020 - 2023, with the reopening of the economy, consumer demand is picking up again. The Chinese Government took several steps to help the real estate sector including cracking down on debt-ridden developers, announcing stimulus for the sector and measures to encourage the completion and delivery of unfinished real estate projects. The sector is now witnessing investments from developers and demand from buyers.

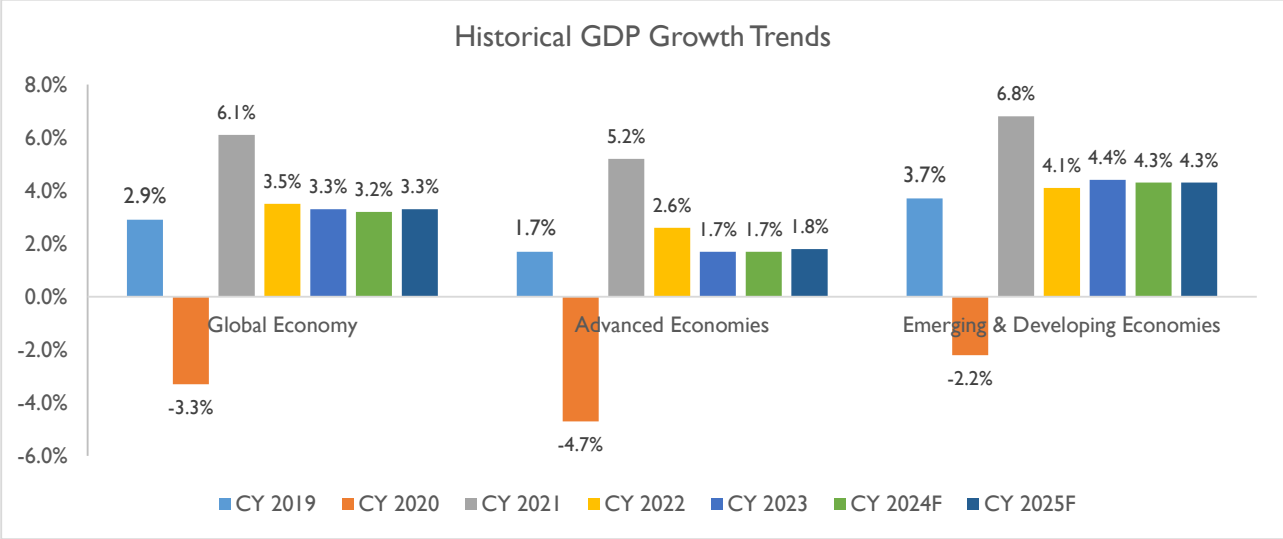
Global headline inflation is set to fall from an estimated 6.8% in CY 2023 to 5.8% in CY 2024 and to 4.4% in CY 2025. This fall is swifter than anticipated across various areas, amid the resolution of supply-related problems and tight monetary policies. Reduced inflation mirrors the diminishing impact of price shocks, particularly in energy, and their subsequent influence on core inflation. This decrease also stems from a relaxation in labour market pressure, characterized by fewer job openings, a slight uptick in unemployment, and increased labour availability, occasionally due to a significant influx of immigrants.

The global economy started to rise from its lowest levels after countries started to lift the lockdown in 2020 and 2021. The lockdown was a key factor as it affected economic activities resulting in a recession in the year CY 2020, as the GDP growth touched -3.3%.

In CY 2021 disruption in the supply chain affected most of the advanced economies as well as low-income developing economies. The rapid spread of COVID Delta variant and the threat of other new variants in mid of CY 2021 further increased uncertainty in the global economic environment.

Global economic activities experienced a sharper-than-expected slowdown in CY 2022. One of the highest inflations in decades, seen in 2022, which forced most of the Central banks to tighten their fiscal policies. Russia’s invasion of Ukraine affected the global food supply resulting in a further increment in the cost of living.

Further, despite initial resilience earlier in 2023, marked by a rebound in reopening and progress in curbing inflation from the previous year's highs, the situation remained precarious. Economic activity lagged its pre-pandemic trajectory, particularly in emerging markets and developing economies, leading to widening disparities among regions. Numerous factors are impeding the recovery, including the lasting impacts of the pandemic and geopolitical tensions, as well as cyclically driven factors such as tightening monetary policies to combat inflation, the reduction of fiscal support amidst high debt levels, and the occurrence of extreme weather conditions. As a result, global growth declined from 3.5% in CY 2022 to 3.3% in CY 2023.



Source – IMF Global GDP Forecast Release July 2024

Note: Advanced Economies and Emerging & Developing Economies are as per the classification of the World Economic Outlook (WEO). This classification is not based on strict criteria, economic or otherwise, and it has evolved over time. It comprises of 40 countries under the Advanced Economies including the G7 (the United States, Japan, Germany, France, Italy, the United Kingdom, and Canada) and selected countries from the Euro Zone (Germany, Italy, France etc.). The group of emerging market and developing economies (156) includes all those that are not classified as Advanced Economies (India, China, Brazil, Malaysia etc.)

Slow growth in developed economies will affect the GDP growth in CY 2024 and global GDP is expected to record a flat growth of 3.2% in CY 2024. The crisis in the housing sector, bank lending, and industrial sectors are affecting the growth of global GDP. Inflation forced central banks to adopt tight monetary policies. After touching the peak in 2022, inflationary pressures slowly eased out in 2023. This environment weighs in for interest rate cuts by many monetary authorities.

Key factors impacting global macroeconomic landscape.

Several key factors influence the global macroeconomic landscape, shaping economic trends and policies worldwide. These include:

Monetary Policy: Central banks' actions regarding interest rates and money supply management (e.g., Federal Reserve, European Central Bank) impact inflation, investment, and consumption. Tightening or loosening monetary policies can either stimulate or slow down economies globally.

Fiscal Policy: Government spending and taxation policies affect aggregate demand, budget deficits, and public debt levels. Expansionary fiscal policies (e.g., stimulus packages) can boost economies, while austerity measures can dampen growth.

Geopolitical Events: Political instability, wars, trade disputes, and sanctions (e.g., Russia-Ukraine conflict, U.S.-China trade tensions) disrupt global trade, supply chains, and capital flows, leading to uncertainty and market volatility.

Inflationary Pressures: Rising energy and commodity prices, supply chain bottlenecks, and labor shortages lead to higher inflation. Central banks may respond with interest rate hikes, influencing borrowing costs and consumer spending globally.

Global Trade and Supply Chains: Trade agreements, tariffs, and disruptions (like the COVID-19 pandemic or geopolitical conflicts) can affect global supply chains, impacting production, trade flows, and prices.

Technological Innovation: Technological advancements, such as automation, artificial intelligence, and digitalization, impact productivity, employment, and economic growth patterns globally. They also shape industry competitiveness and job markets.

Climate Change and Environmental Policy: The transition to green energy, carbon regulations, and climate change adaptation affect industries, investment flows, and government policies. Global commitments to reduce emissions influence sectors like energy, manufacturing, and transportation.

Demographic Shifts: Aging populations in developed economies (e.g., Japan, Europe) and growing working-age populations in emerging markets affect labor force dynamics, social spending, and economic growth trends.

Global Debt Levels: Rising public and private debt, exacerbated by the COVID-19 pandemic and high borrowing during low interest-rate periods, poses risks to financial stability. High debt levels can limit governments' ability to respond to future crises.

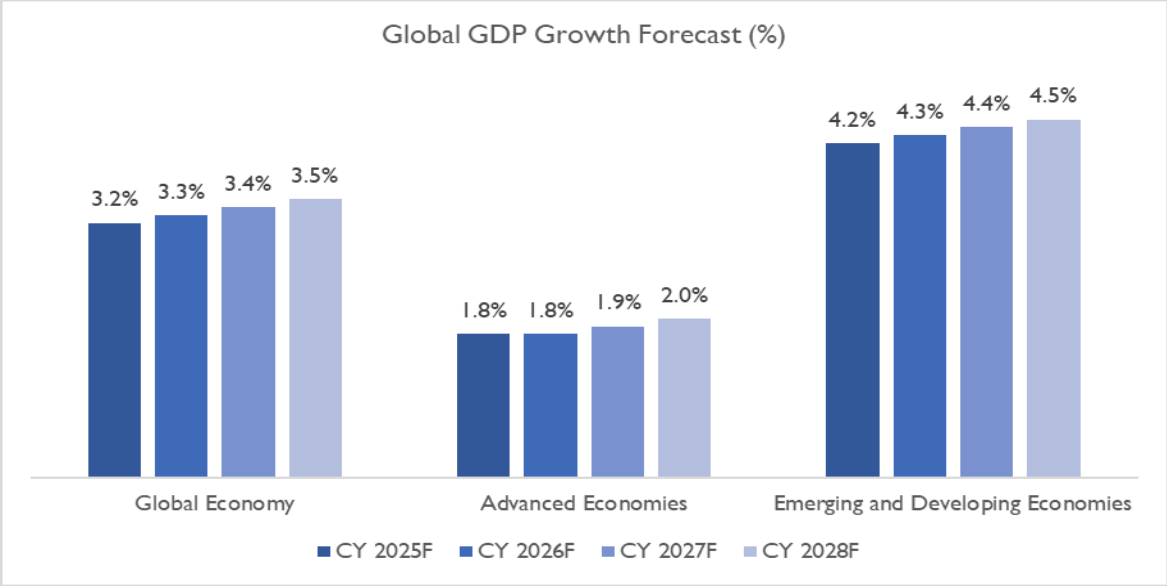
Commodity Prices: Oil, natural gas, metals, and agricultural commodity price fluctuations significantly impact economies, especially those dependent on resource exports. Energy crises and price shocks (e.g., due to geopolitical instability) affect inflation and growth.

Pandemics and Health Crises: Global health crises like the COVID-19 pandemic cause widespread economic disruption, affecting labor markets, travel, and consumption patterns, while forcing governments to rethink healthcare and social support systems.

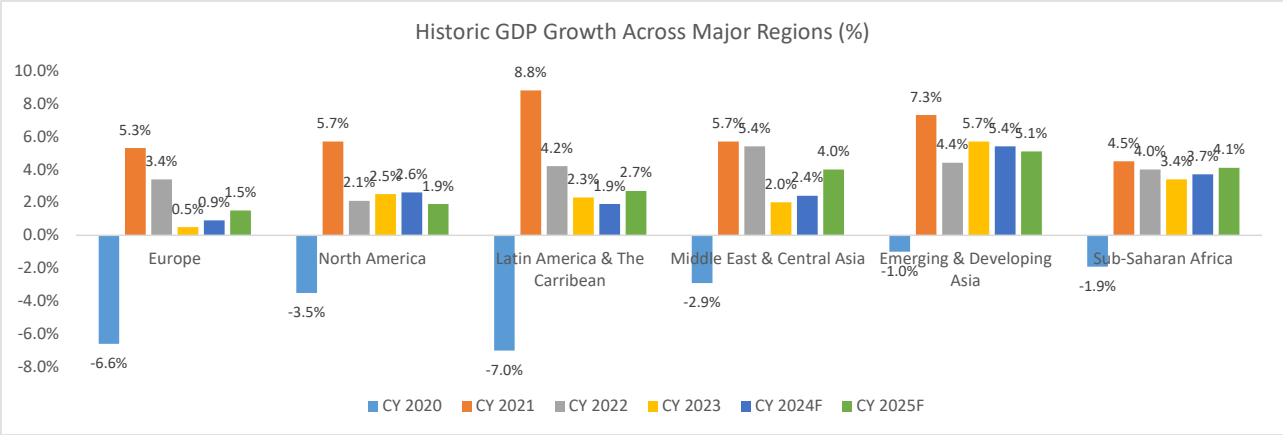
Globalization vs. Regionalization: The balance between global integration and regional economic blocs (e.g., the EU, ASEAN) affects trade policies, foreign investments, and economic interdependence.

Growth Forecast: Global and Regional

GDP growth of major regions including Europe, Latin America & The Caribbean, Middle East & Central Asia, and Sub-Saharan Africa, were showing signs of slow growth and recession between 2020 – 2023, but leaving Latin America & The Caribbean, 2024 is expected to show resilience and growth. Meanwhile, GDP growth in Emerging and Developing Asia (India, China, Indonesia, Malaysia etc.) is expected to decrease from 5.4% in CY 2023 to 5.2% in CY 2024, while in the United States, it is expected to decrease from 2.5% in CY 2023 to 2.1% in CY 2024.



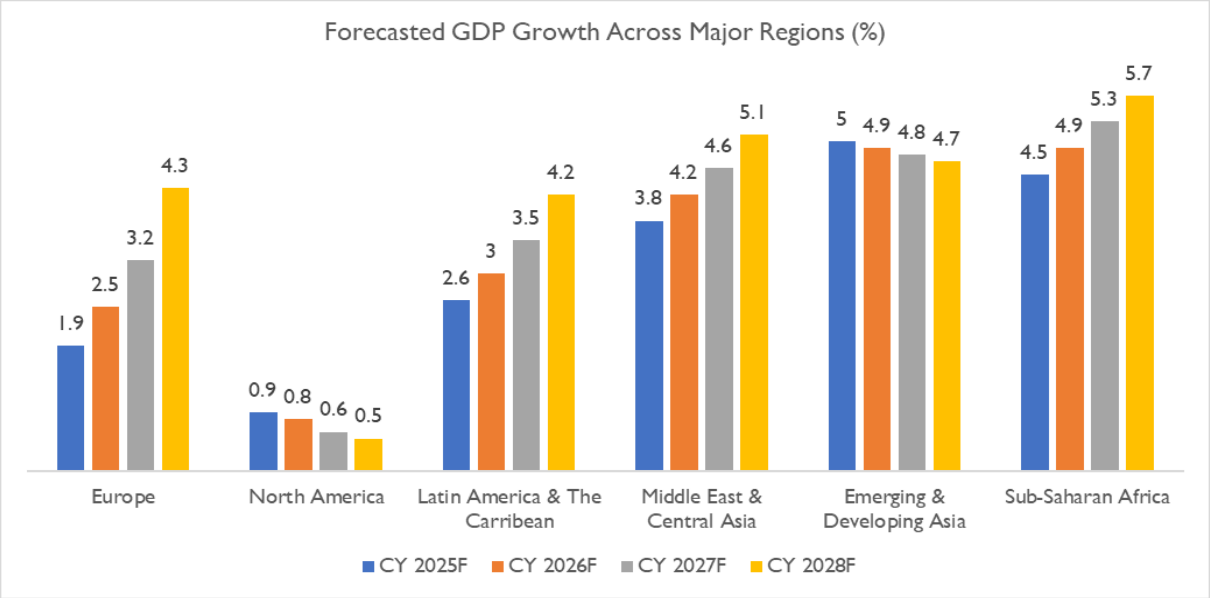
Source – IMF Global GDP Forecast Release 2024, D&B Estimates



Source-IMF World Economic Outlook July 2024 update.

Except for Emerging and Developing Asia, Latin America & The Caribbean and the United States, all other regions are expected to record an increase in GDP growth rate in CY 2024 as compared to CY 2023. GDP growth in Latin America & The Caribbean is expected to decline due to negative growth in Argentina. Further, growth in the United States is expected to come down at 2.1% in CY 2024 due to lagged effects of monetary policy tightening, gradual fiscal tightening, and a softening in labour markets slowing aggregate demand.

Although Europe experienced a less robust performance in 2023, the recovery in 2024 is expected to be driven by increased household consumption as the impact of energy price shocks diminishes and inflation decreases, thereby bolstering real income growth. Meanwhile, India and China saw greater-than-anticipated growth in 2023 due to heightened government spending and robust domestic demand, respectively. Sub-Saharan Africa's expected growth in 2024 is attributed to the diminishing negative impacts of previous weather shocks and gradual improvements in supply issues.



Source-IMF, OECD, and World Bank, D&B Estimates

At the midpoint of the year, so far in 2024 we have seen divergence in outcomes and prospects around the world in terms of economic growth, inflation, and policy responses. On balance, global short-term economic prospects have improved over the course of the year. We expect this momentum to continue through the second half of 2024 and into 2025 as inflation eases further and monetary policy continues to loosen, supporting steady growth. Macroeconomic risks, in our view, have become more balanced.

The U.S. has performed better than other developed economies, particularly those in Europe where the consumer sentiment has been relatively weak – though the picture in Europe has been varied. A sustained recovery in tourism this year has boosted the economies of Greece and Spain, whereas Germany, France, and Italy have been held back by the slower recovery of manufacturing. Nonetheless, the European Central Bank (ECB) lowered the three key interest rates in June – for the first time since September 2019 – which will support stronger regional growth.

Growth in the Chinese Mainland has held up well so far this year despite challenges from the property market amid ongoing rebalancing, and the export cycle is supporting growth in the rest of Asia. In Latin America, larger economies, such as Brazil and Mexico, tend to be performing more moderately than smaller economies, such as Chile and Peru, indicating slower regional growth overall.

Globally, industrial production has been relatively sluggish because of restrictive trade policies, persistent supply chain disruptions, high interest rates, and anemic growth. We expect industrial production to

gather steam later this year and into 2025 on the back of a gradual recovery in global trade, stimulated by stronger domestic demand for goods.

Policy responses have diverged so far this year and are set to remain so in the near term. Central banks have begun rate cutting cycles in several developed economies, including the Eurozone, Canada, Sweden, and Switzerland. However not every economy has followed suit. Disinflation has not been as predictable as it was in 2023, and underlying price pressures mean inflation is likely to remain bumpy this year – hence, policy will remain more restrictive than was anticipated at the start of the year. With relatively stronger economic growth and stickier inflation, the timing of the first interest rate cut by the U.S. Federal Reserve (the Fed) and the onward path of interest rates remains ambiguous.

The global economy is showing signs of stabilizing, yet growth will remain subdued this year before picking up pace in 2025. We forecast global growth of around 2.5% in 2024, half a percentage point softer than in the decade following the financial crisis. The weaker outlook reflects fiscal consolidation, lagged tight monetary policy, restrictive trade policies, and elevated levels of geopolitical uncertainty. Looking ahead to 2025, global growth is likely to pick up slightly to 2.8% as the impact of these factors declines and stronger growth becomes more entrenched.

Emerging economies look set for softer growth in general this year. On a regional basis, growth is likely to be markedly slower in Eastern Europe, but only slightly softer in Asia Pacific and Latin America, with growth only moderately slower in key economies such as the Chinese Mainland, India, and Brazil. Outcomes in developed economies are also mixed but largely remain subdued because of tight policy settings.

India Macro- Economic Overview

Historical analysis of economic growth: annual GDP growth pattern

India's economy showed resilience with GDP growing at 8.2% in CY 2023. The GDP growth in CY 2023 represents a return to pre-pandemic era growth path. Even amidst geopolitical uncertainties, particularly those affecting global energy and commodity markets, India continues to remain one of the fastest growing economies in the world.

Country	Real GDP Growth (CY 2023)	Projected GDP Growth (CY 2024)	Projected GDP Growth (CY 2025)
India	8.20%	7.00%	6.50%
China	5.20%	5.00%	4.50%
Russia	3.60%	3.20%	1.50%
Brazil	2.90%	2.10%	2.40%
United States	2.50%	2.60%	1.90%
Japan	1.90%	0.70%	1.00%
Canada	1.20%	1.30%	2.40%
Italy	0.90%	0.70%	0.90%
France	1.10%	0.90%	1.30%
South Africa	0.70%	0.90%	1.20%
United Kingdom	0.10%	0.70%	1.50%
Germany	-0.20%	0.20%	1.30%

Source: World Economic Outlook, July 2024, Countries considered include - Largest Developed Economies and BRICS (Brazil, Russia, India, China, and South), Countries have been arranged in descending order of GDP growth in 2023).

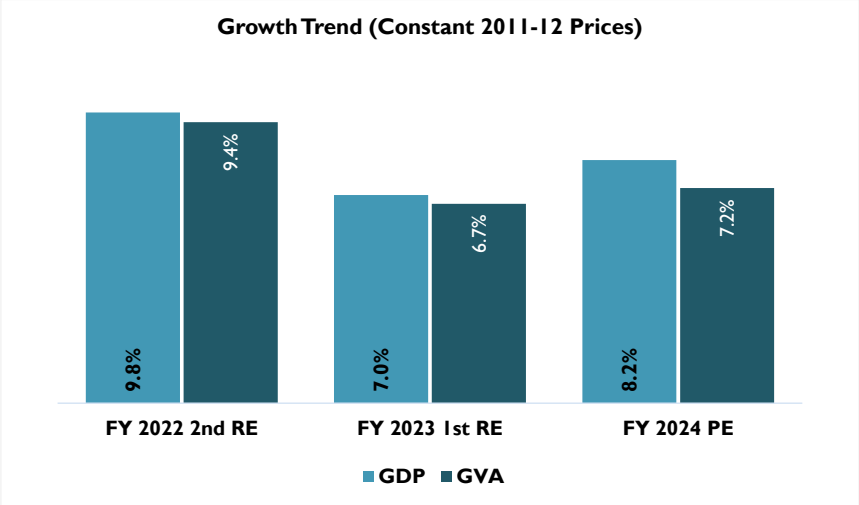
There are few factors aiding India's economic recovery – notably its resilience to external shocks and rebound in private consumption. This rebound in private consumption is bringing back the focus on improvements in domestic demand, which together with revival in export demand is a precursor to higher industrial activity. Already the capacity utilization rates in Indian manufacturing sector are recovering as industries have stepped up their production volumes. As this momentum sustains, the country may enter a new capex (capital expenditure) cycle. The universal vaccination program by the Government has played a big part in reinstating confidence among the population, in turn helped to revive private consumption.

Realizing the need to impart external stimuli, the Government stepped up its spending on infrastructure projects which in turn had a positive impact on economic growth. The capital expenditure of the central government increased by 37.4% increase in capital expenditure (budget estimates), to the tune of INR 10 trillion in the Union Budget 2023-2024. The announcement also included a 30% increase in financial assistance to states at INR 1.3 trillion for capex. The improvement was accentuated further as the Budget 2024-2025 announced an 11.1% increase in the capital expenditure outlay at INR 11.11 trillion, constituting 3.4% of the GDP. This has provided much-needed confidence to the private sector, and in turn, attracted private investment.

On the lending side, the financial health of major banks has witnessed an improvement which has helped in improving the credit supply. With capacity utilization improving, there would be demand for credit from

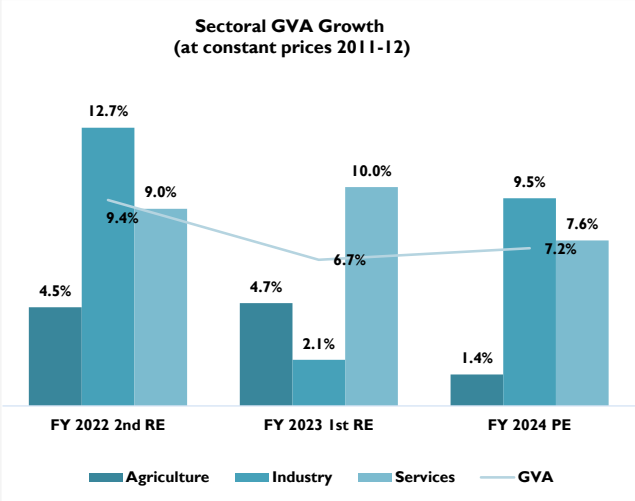
the corporate sector to fund the next round of expansion plans. The banking industry is well poised to address that demand. Underlining the improving credit scenario is the credit growth to the micro, small, and medium enterprise (MSME) sector as the credit outstanding to the MSME sector by scheduled commercial banks in the fiscal year 2024 grew by 14% to INR 10.31 trillion compared to INR 9.02 trillion as on 24 March 2023. The extended Emergency Credit Linked Guarantee Scheme (ECLGS) by the Union Government has played a major role in improving this credit supply.

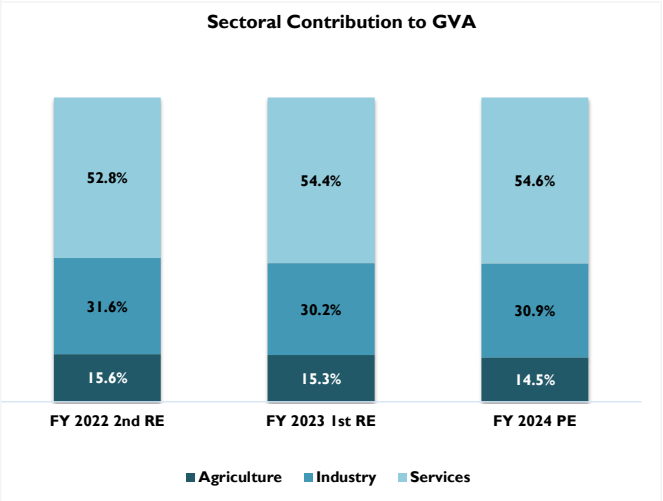
As per the provisional estimates 2023-24, India's GDP in FY 2024 grew by 8.2% compared to 7.0% in the previous fiscal on the back of solid performances in manufacturing, mining, and construction sectors. The year-on-year increase in growth rate is also partly due to by a strong growth in investment demand led by public capital expenditure.



Source: Ministry of Statistics & Programme Implementation (MOSPI), National Account Statistics, 2023-24
RE stands for Revised Estimates, SAE stands for Second Advance Estimates

Sectoral GDP Growth Pattern





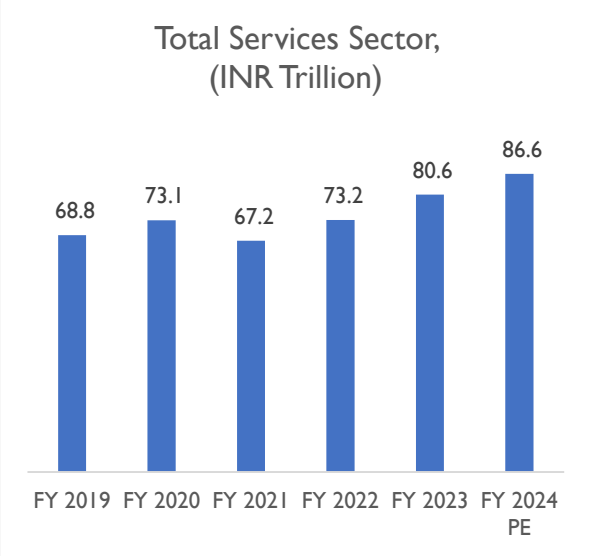
Source: Ministry of Statistics & Programme Implementation (MOSPI)

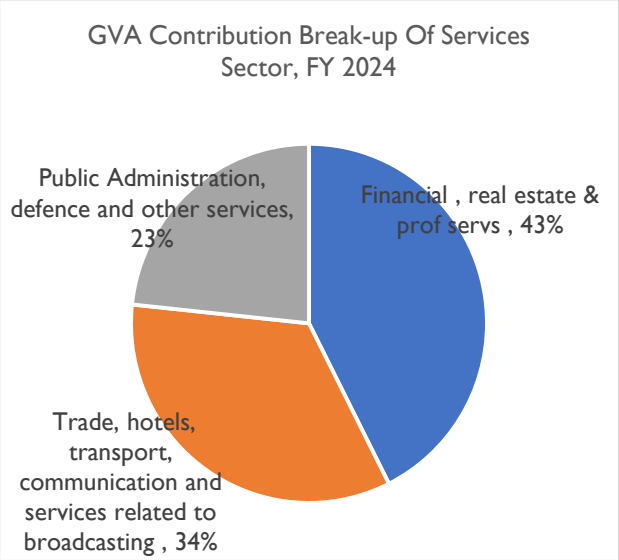
Sectoral analysis of GVA reveals industrial sector recovered sharply registering 9.5% y-o-y increase in FY 2024 against 2.1% in the previous fiscal. In the industrial sector, growth across major economic activity such as mining, manufacturing and construction sector rose significantly and it registered a growth of 7.1%, 9.9% and 9.9% in FY 2024 against a y-o-y change of 1.9%, -2.20%, and 9.44% in FY 2023, respectively. Utilities sector observed a marginal moderation in y-o-y growth to 7.5% against 9.44% in the previous years.

Talking about the services sector's performance, with major relaxation in COVID restriction, progress on COVID-19 vaccination and living with virus attitude, business in the service sector gradually returned to normalcy in FY 2023. Economic recovery was supported by the service sector as individual mobility returned to the pre-pandemic level. The trade, hotel, transport, communication, and broadcasting segment continued to strengthen in FY 2023 and grow in FY 2024, although the growth hasn't shown substantial increases. In FY 2024, services sector grew by 7.6% against 10% y-o-y growth in the previous year.

Expansion in Service Sector

Services sector is a major contributor to the country's overall economic growth. In absolute terms, services sector GVA has increased from INR 68.78 trillion in FY 2019 to INR 86.6 trillion in FY 2024 (as per the provisional estimated), registering a CAGR of nearly 5%. Within Services sector, the GVA by financial, real estate and professional services-the largest contributing segment observed 6.3% CAGR while Public Administration, defense and other services[1] observed 4.5% CAGR and Trade, hotels, transport, communication, and services related to broadcasting witnessed 3.1% CAGR between FY 2019-24.





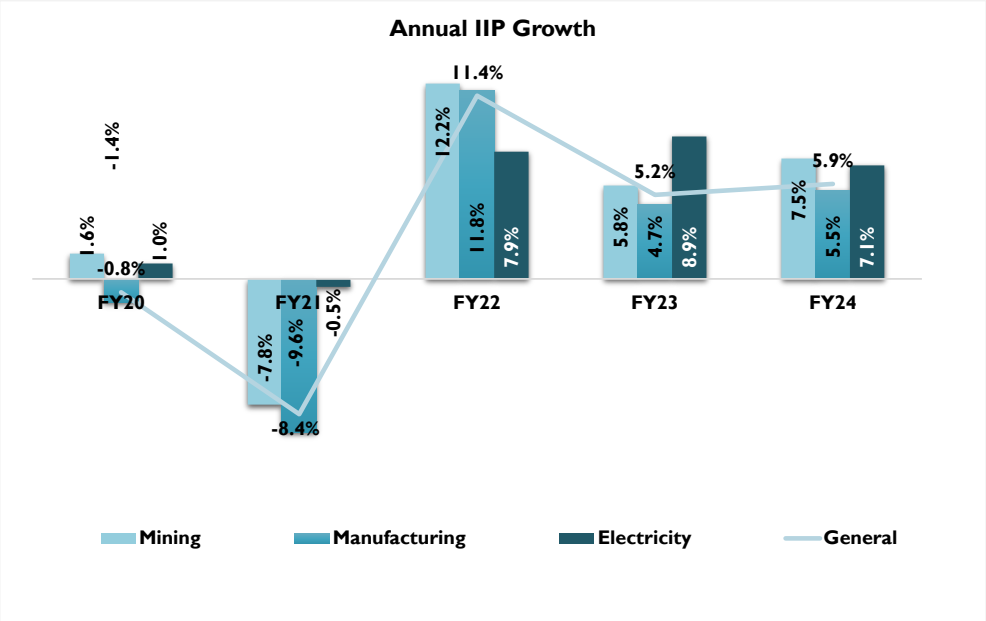
Sources: MOSPI, CMIE Economic Outlook and Dun & Bradstreet Research Estimates[2]

India's HSBC Services Purchasing Managers' Index**,** an important indicator to track service sector performance, measured 60.3 in July 2024 against 60.5 in the previous month. Since August 2021, the services sector has consistently remained above the threshold of 50, which distinguishes growth from contraction.

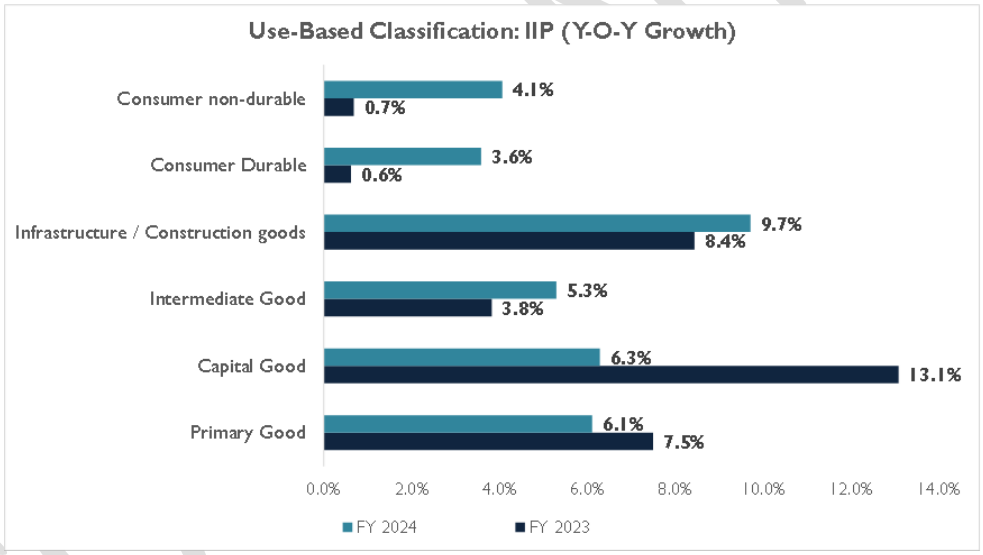
Mapping the industrial activity in India: Analysis of changes in Index of Industrial Production (IIP)

Industrial sector performance as measured by IIP index; in FY 2024 it is growing at 5.9% (against 5.2% in FY 2023). Previously IIP index exhibited temporary recovery in FY 2022 from the low of COVID induced slowdown in industrial growth during FY 2020 and FY 2021. Manufacturing index, with 77.6% weightage in overall index, grew by 5.5% in FY 2023 against 4.7% y-o-y growth in FY 2022 while mining sector index too grew by 7.5% against 5.8% in the previous years. Mining & manufacturing both shown improvement according to previous except the Electricity sector Index, witnessed an improvement of 7.1% against 8.9% in the previous year.

[1] Other services include Education, Health, Recreation, and other personal services.
[2] Projection as Based on CMIE Growth rate till FY 2029 and FY 2030 is based on Dun & Bradstreet assumption.

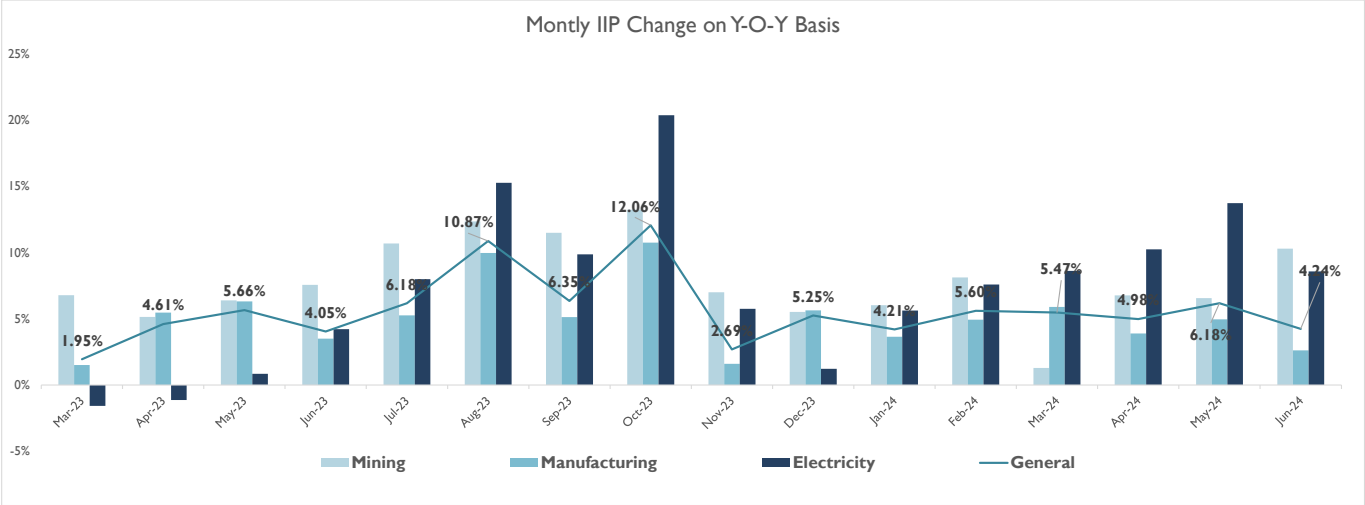


Source: Ministry of Statistics & Programme Implementation (MOSPI)



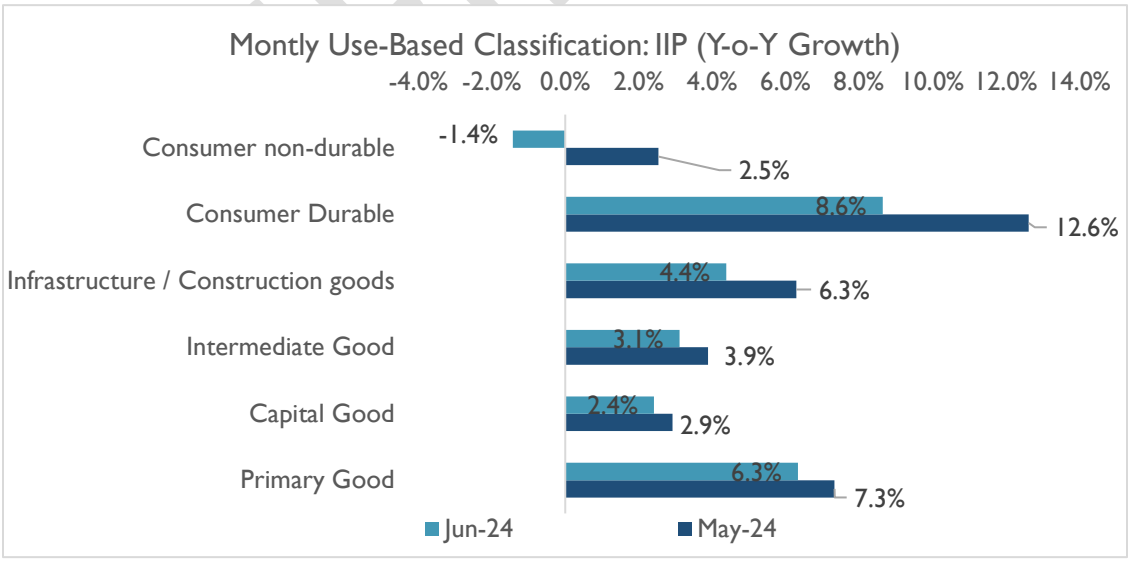
As per the use-based classification, most of the segments has shown growth for FY 2024 as compared to FY 2023. Capital good and primary goods were segments which faced less growth as compared to previous year. The contracting IIP data points towards adverse operating business climate as global headwinds, high inflation, and monetary tightening cumulatively impacted the broader industrial sector performance. In contrast all the segments except the above two have shown growth.

Monthly IIP Growth Trend



Source: Ministry of Statistics & Programme Implementation (MOSPI)

- In the current fiscal FY 2025, the monthly IIP measured index has reported steady improvement over the last fiscal. However, the IIP index slowed to a 5-month low and just grew by 4.24% y-o-y in June against 6.18% in the previous month on the back of slowing growth in the manufacturing section. In June 2024, the manufacturing index growth slowed to 2.6% against 6.3% y-o-y growth in June 2023 and 5% in May 2023 while the electricity sector index and mining index exhibited substantial improvement and they grew by 8.6% and 10.3% in June 2024 against 0.9% and 6.4% growth in April 2023, respectively.

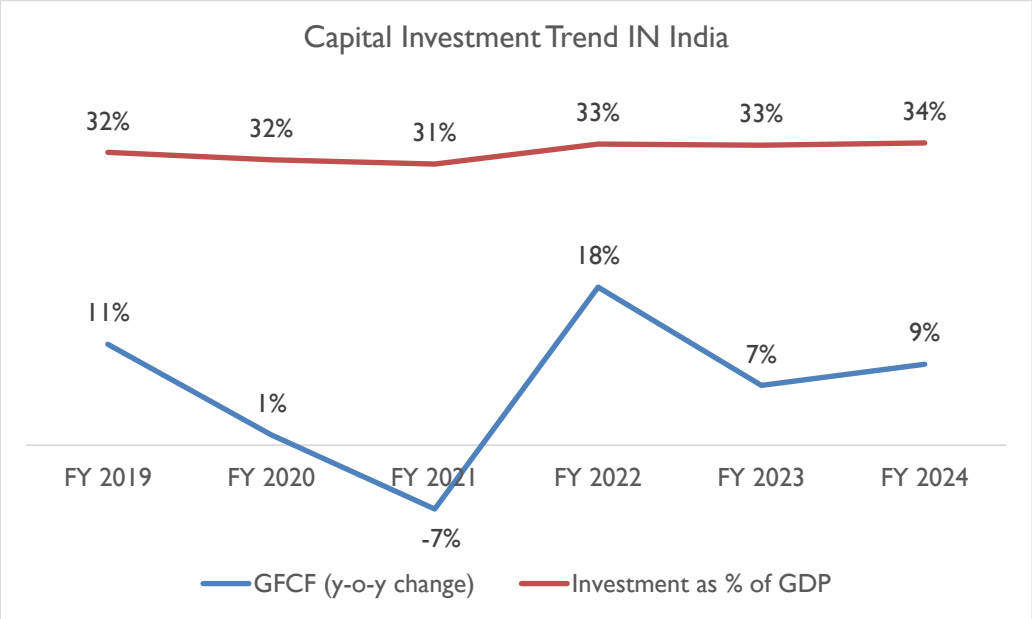


Sources: MOSPI

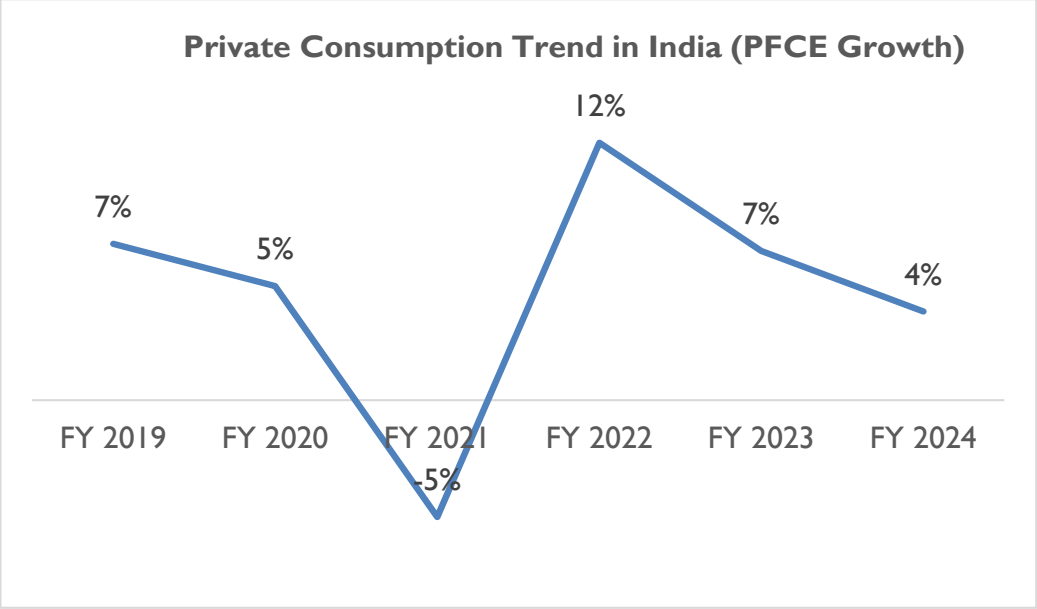
As per the use-based classification, growth in all segments slowed in June 2024 as compared to the previous month. Consumer non-durable declined by 1.4% in June 2024 against 2.5% increase in the previous month. In May 2024, all segments showed a substantial increase in growth.

Growth Trend in Investment & Consumption Demand

Other major indicators such as Gross Fixed Capital Formation (GFCF), a measure of investments, gained strength during FY 2024 as it grew by 9% on a y-o-y basis against 7% yearly growth in the previous fiscal, while GFCF to GDP ratio measured an all-time high settled higher at 34%.



Sources: MOSPI

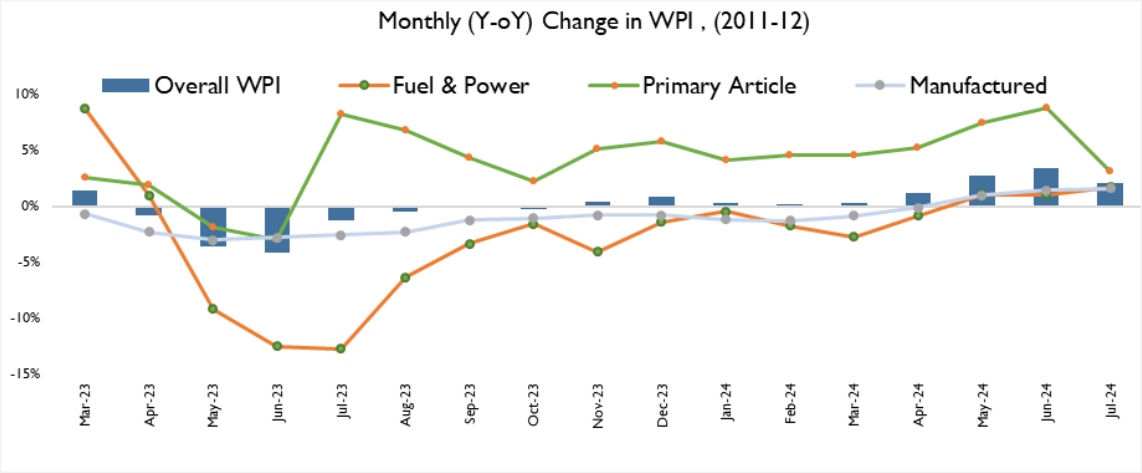


Sources: MOSPI

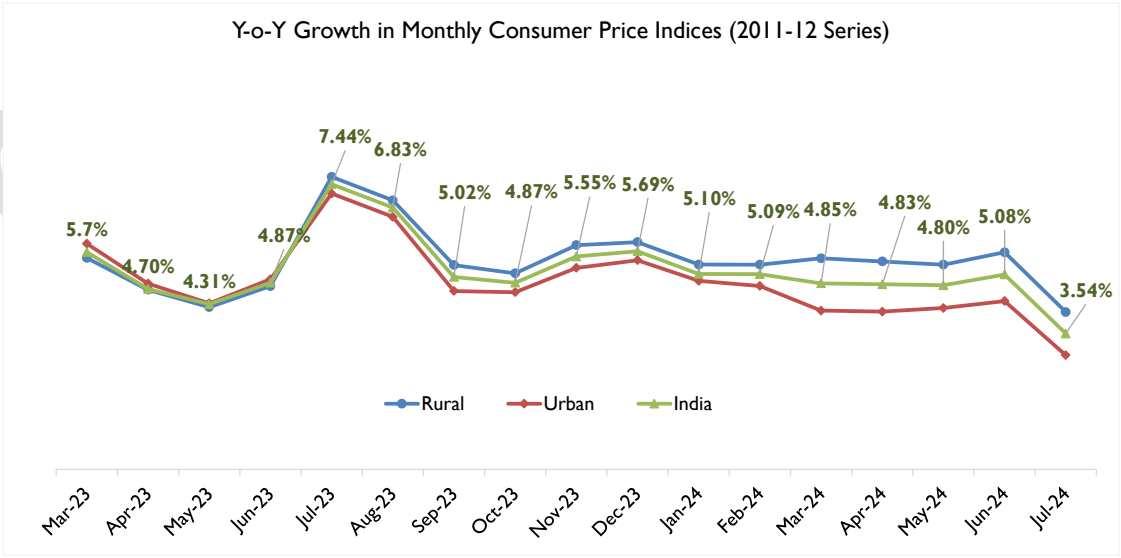
Private Final Expenditure (PFCE) a realistic proxy to gauge household spending, observed decelerated and registered 4% y-o-y growth in FY 2024 against 7% in FY 2023.

Inflation Scenario and Interest Rate movement

The inflation rate based on India's Wholesale Price Index (WPI) exhibited significant fluctuations across different sectors from March 2023 to July 2024. Overall WPI saw a sharp decline to -1.2% in July 2023, primarily driven by steep drops in Fuel & Power and Manufactured Products, reflecting reduced global demand and falling input costs. However, a recovery was noted by June 2024, with WPI reaching 3.4%, supported by a strong rise in Primary Articles and a rebound in Fuel & Power prices. By July 2024, while Primary Articles growth moderated to 3.1%, the WPI remained positive at 2.0%, indicating stabilization in the market after earlier volatility.



Source: MOSPI, Office of Economic Advisor.



Source: CMIE Economic Outlook

Retail inflation rate (as measured by the Consumer Price Index) in India showed notable fluctuations between March 2023 and July 2024. Rural CPI inflation peaked at 7.63% in July 2023, before declining to 4.10% in July 2024. Urban CPI inflation followed a similar trend, rising to 7.20% in July 2023 and then dropping to 2.98% in July 2024. Overall, the national CPI inflation rate increased to 7.44% in July 2023 but moderated to 3.54% by July 2024, indicating a gradual easing of inflationary pressures across both rural and urban areas over the period. CPI measured below 6% tolerance limit of the central bank since September 2023. As a part of an anti-inflationary measure, the RBI has hiked the repo rate by 250 bps since May 2022 to the current 6.5% while it has been holding the rate at 6.5% since 8 Feb 2023.

Key growth/demographic drivers for economic growth

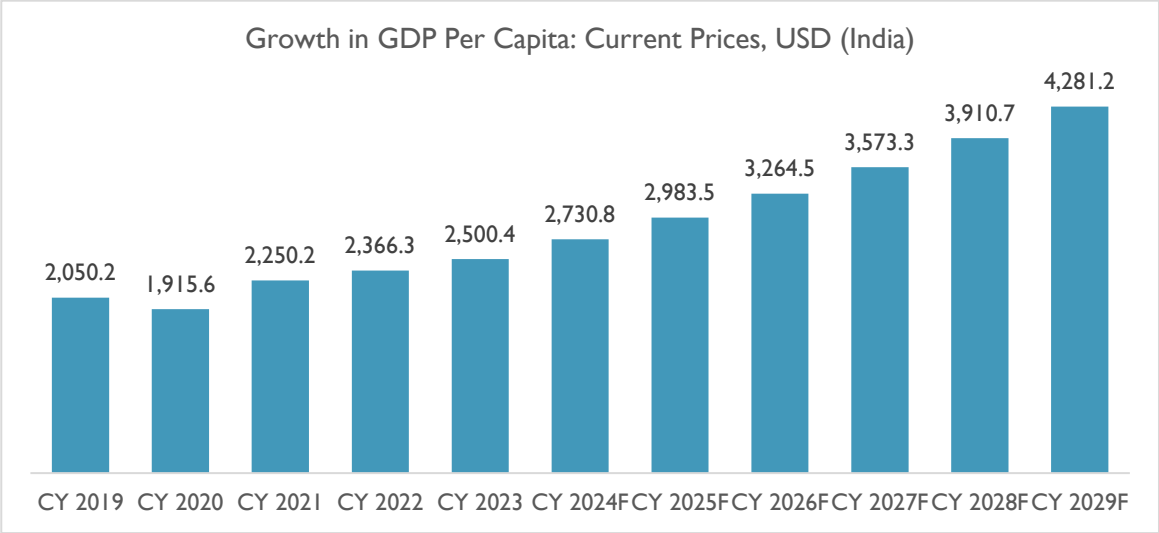
Strong Domestic Demand

Domestic demand has traditionally been one of the strong drivers of Indian economy. After a brief lull caused by COVID-19 pandemic, the domestic demand is recovering. Consumer confidence surveys by Reserve Bank / other institutions points to an improvement in consumer confidence index, which is a precursor of improving demand. India has a strong middle-class segment which has been the major driver of domestic demand. Factors like fast paced urbanization and improving income scenario in rural markets are expected to accelerate domestic demand further. PFCE as a percentage of GDP increased to 58% during FY 2022 and FY 2023 while in FY 2024 it settled at 56%. There are two factors that are driving this domestic demand: One the large pool of consumers and second the improvement in purchasing power. As per National Statistics Office (NSO), India's per capita net national income (at constant prices) stood at INR 106,744 in FY 2024 against INR 99,404 in FY 2023 and INR 87,586 in FY 2018. This increase in per capita income has impacted the purchasing pattern as well as disposable spending pattern in the country. Consumer driven domestic demand is majorly fueled by this growth in per capita income.

India's Per capita GDP trends

India is poised to become the world's third-largest economy with a projected GDP of USD 5 trillion within the next three years, driven by ongoing reforms. As one of the fastest-growing major economies, India currently holds the position of the fifth-largest economy globally, following the US, China, Japan, and Germany. By 2027-28, it is anticipated that India will surpass both Germany and Japan, reaching the third-largest spot. This growth is bolstered by a surge in foreign investments and a wave of new trade agreements with India's burgeoning market of 1.4 billion people. The aviation industry is witnessing unprecedented orders, global electronics manufacturers are expanding their production capabilities, and suppliers traditionally concentrated in southern China's manufacturing hubs are now shifting towards India.

To achieve its vision of becoming the world's third-largest economy by 2027-28, India will need to implement transformative industrial and governmental policies. These policies will be crucial for sustaining the consistent growth of the nation's per capita GDP over the long term.



Source: IMF

From CY 2024-29, India's per capita GDP is projected to grow at a compound annual growth rate of 9.4%. This growth will be driven by the service sector, which now accounts for over 50% of India's GDP, marking a significant shift from agriculture to services.

Digitization Reforms

Ongoing digitization reforms and the resultant efficiency gains accrued would be a key economic growth driver in India in the medium to long term. Development of digital platforms has helped in the seamless roll out of initiatives like UPI (Unified Payments Interface), Aadhaar based benefit transfer programs, and streamlining of GST (Goods and Services Tax) collections. All of these have contributed to improving the economic output in the country. Some of the key factors that have supported the digitization reforms include – the growth in internet penetration in India together with drop in data tariffs, growth in smartphone penetration, favorable demographic pattern (with higher percentage of tech savvy youth population) and India's strong IT (Information Technology) sector which was leveraged to put in place the digital ecosystem. All these factors are expected to remain supportive and continue to propel the digitization reforms in India.

Increased adoption of digital technology and innovation, inclusive and sustainable practices, business-friendly and transparent regulations, and heightened corporate research and development (R&D)

investments will further bolster the country's growth. These factors will collectively support employment growth across both private and public sectors, including Micro, Small, and medium enterprises (MSMEs).

An Overview: Automation Solution Industry

The global manufacturing industry is evolving rapidly, as it integrates the latest technologies and processes. The last few decades were characterized by increasing use of machines in factories, which slowly replaced manual labor. In several advanced economies, core manufacturing sectors are fully automated with industrial robots carrying out most of the production process. Human intervention is limited to supervisory and monitoring roles.

Developments like integrated systems, manufacturing automation, applications of enterprise resource planning tools, and such techniques have become the norm in manufacturing plants. Although developing economies like India are yet to fully adopt these practices, the gulf that existed between factories in developed economies and developing economies is gradually coming down.

These changes were shaped not only by technological breakthroughs – although this could be termed as an integral factor. Changes in global business models, especially the onset of globalization and free trade, too played a role. Free market regime and lifting of trade barriers made the movement of goods and services easier, hence opening additional markets. The changes in global industrial regime made previously existing geographical restrictions irrelevant.

These developments made it easier for companies to go beyond their home market and compete in foreign markets. However, the changes that created opportunities have also changed the nature of competition. The competition for a company is no longer limited to its peers in the same geography, but include companies operating in the foreign market, as the world transformed into a single market. Modernization of the manufacturing process and incorporation of latest technologies became a norm rather than an exception to stay relevant and successfully ward of competition. Additionally, companies began to focus more on improving efficiency and reducing cost to stay nimble and competitive.

All these changes meant industrial processes, equipment, and machines are monitored on a far more regular basis, often round the clock. This is most evident in developed economies, where industrial automation and monitoring has become an integral part of the manufacturing eco-system. These aspects are yet to become a norm in Indian as well as other developing economies and is currently limited to large manufacturing plants. However, sooner or later Indian manufacturing sector too would wake up to the importance of industrial monitoring and control and embrace the concept fully.

The innovations that have propelled industrial automation is more a result of targeted applications and requirements, rather than the introduction of hot new technologies. The evolution from relay logic to programmable control logic (PLC) to distributed control systems (DCS) to sensors has been driven by this requirement from the user segment. The arrival of personal computer, and associated hardware and software could be considered a watershed moment as it helped in reducing cost as well as complexity. Automation become much more democratized, unlike earlier times when it solely the domain of large industries. **The word automation refers to a self-dictating process or move which is derived from the Greek words Auto which means self and Matos which means moving.**

Industrial automation *can be defined* as the use of certain technologies and control devices for automatic operation and control of industrial processes without significant human intervention which results in achieving superior performance than manual control. It helps businesses to enhance safety, boost quality production, reduce monitoring, and lower costs that eventually helps companies to achieve higher productivity, greater efficiency, and more profitability.

Industrial automation has become a driving force behind economic transformation, reshaping industries, and economies worldwide. Increasing focus on process efficiency, waste reduction, and cost optimization are forcing Indian manufacturing sector to reinvent themselves. With advancements in technology and the adoption of automation solutions, industries across various sectors are experiencing increased efficiency, productivity, and competitiveness. In the context of the Indian economy, industrial automation is playing a crucial role in accelerating growth, and opportunities. Indian manufacturing sector, primarily the organized segment consisting of large and established players, is eagerly adopting technological solutions. The level of automation and technology adoption in the Indian manufacturing sector is witnessing a steady growth.

These days a wide range of industrial automation tools such as Programmable Logic Controller (PLC), Supervisory Control and Data Acquisition (SCADA), Human Machine Interface (HMI), Artificial Neural Network (ANN), Distributed Control System (DCS), assembly line automation, Welding Automation and Robotics are being used by industrial sector to boost productivity and cut costs.

Industrial Automation Application in Automotive Sector

Industrial automation has become a cornerstone of the automotive sector, revolutionizing production efficiency, precision, and scalability. The journey of industrial automation in the automotive sector began in the early 20th century with Henry Ford's introduction of the assembly line for mass production. This marked the initial shift towards mechanized systems to improve production speed and consistency. Over the decades, automation technologies evolved from simple mechanical aids to sophisticated electromechanical systems. The 1950s saw the emergence of programmable logic controllers (PLCs), enabling greater control over machinery operations. The advent of computer numerical control (CNC) in the 1970s further enhanced precision and flexibility in manufacturing processes. By the 1980s and 1990s, the integration of robotics became prevalent, especially in tasks requiring high precision and repeatability, such as welding and painting. The introduction of sensors, machine vision, and early AI algorithms in the late 1990s and early 2000s paved the way for smarter and more adaptive automation systems.

Key Milestones in Automotive Automation

- **1913**: Introduction of the moving assembly line by Henry Ford, reducing production time significantly.
- **1954**: Deployment of the first industrial robot, "Uniate," in General Motors' manufacturing plant.
- **1970s**: Widespread adoption of CNC machines, enhancing precision in automotive manufacturing.
- **1980s**: Integration of robotic welding and painting systems in assembly lines.
- **1990s**: Emergence of machine vision and sensors for quality inspection and adaptive manufacturing.
- **2010s**: Introduction of collaborative robots and AI-driven predictive maintenance tools.
- **2020s**: Rapid adoption of IoT and edge computing in manufacturing processes, enabling real-time monitoring and optimization.

Shifts from Manual Labor to Robotic and AI-driven Systems

The transition from manual labor to automated systems in the automotive sector has been transformative. Initially, automation served as a support to human workers, handling repetitive or hazardous tasks. However, with advancements in robotics and artificial intelligence, automation systems have moved towards complete autonomy in various production stages. Robotic arms now dominate welding lines, ensuring consistent and precise welds with minimal human intervention. Conveyor systems have evolved to integrate smart controls and IoT devices, optimizing material flow and reducing bottlenecks. Assembly lines, which once relied on human dexterity, are now equipped with robots capable of performing intricate

tasks with high precision. Special-purpose machinery, designed for specific manufacturing needs, incorporates AI-driven diagnostics and predictive maintenance, reducing downtime and improving overall productivity.

The latest shift involves collaborative robots (cobots) and AI-enhanced systems that work alongside human operators. These systems leverage machine learning algorithms to adapt to changing production requirements and improve efficiency in real-time. Today, clients are demanding more tailored automation systems which expands the automation solution scope in application in bespoke assembly lines, specialized machinery for handling new materials besides welding lines, conveyor systems. Below is a comprehensive exploration of this domain. This includes and the integration of legacy systems.

Welding Application in Automobile Industry

The welding process, a part of metal fabrication process, forms the backbone of the manufacturing sector which account for approximately 17% of India's GDP. Welding process is critical for many manufacturing processes where the welding quality welding has a direct impact on the quality of the final product. Design / specification of the product to be fabricated is provided by the customer, and fabrication companies majorly focus only on the operational part of executing the fabrication work as per the supplied designs. Depending upon the product, a wide range of metals – both common as well as exotic – is used for fabrication. Steel and aluminum are two major input materials used in fabrication industries.

Metal fabrication facilities (also referred to as fab shops) are often run by independent contractors, Original Equipment Manufacturers and Value-Added Resellers. In the metal fabrication industry, the welding process can be segmented into manual and robotic systems, each serving distinct roles across various industries.

Manual Welding Systems: Encompasses techniques where human operators control the welding process. Key methods include the following:

- ***Manual Metal Arc Welding (MMAW):*** Also known as Shielded Metal Arc Welding (SMAW), this method uses a consumable electrode coated in flux to lay the weld.
- ***Manual Metal Inert Gas (MIG) Welding:*** Utilizes a continuous solid wire electrode fed through a welding gun, protected by an inert gas shield.
- ***Manual Tungsten Inert Gas (TIG) Welding:*** Employs a non-consumable tungsten electrode to produce the weld, with a separate filler material if needed.

- ***Manual Spot Welding:*** Involves joining two metal surfaces by applying pressure and heat from an electric current to the weld area.

These manual systems are prevalent in sectors such as construction, automotive repair, and small-scale manufacturing, where flexibility and human expertise are essential.

Welding automation in the Automobile Sector

Welding automation has played a pivotal role in the automotive industry, enabling the industry to manufacture reliable, fuel-efficient and environment friendly vehicles in volume. Welding process is critical in getting a strong, and durable connections between various metal components, such as the vehicle's body, frame, and suspension system. From assembly lines to repair shops, welding technologies are evolving and increasingly automated to meet the growing demands of the automotive industry.

Robotic Welding Systems: Robotic welding integrates automated machinery to perform welding tasks with precision and efficiency. Key components include:

- **Robotic Arms:** Programmable mechanical arms equipped with welding tools, capable of performing complex welds with high accuracy.
- **Automated Guided Vehicles (AGVs)**: Mobile robots that transport materials and components within manufacturing facilities, enhancing workflow efficiency.

The adoption of robotic welding systems is accelerating in industries such as automotive manufacturing, heavy engineering, and large-scale fabrication. These systems offer advantages like consistent weld quality, increased production speed, and reduced labor costs.

Product Overview of Welding fixtures

Welding Fixtures: Welding fixtures are essential for holding and positioning components during welding to ensure precision and consistency. Indian companies provide various types of welding fixtures:

- Manual Welding Fixtures: Designed for manual operations, these fixtures support processes like MIG, TIG, and spot welding. For instance, Cyclotron Automation specializes in manufacturing manual welding fixtures tailored for automotive and construction industries.
- Robotic Welding Fixtures: These fixtures are integrated with robotic systems to facilitate automated welding processes. Companies like Dran Engineers offer robotic welding fixtures suitable for two-wheeler, three-wheeler, and BIW (Body-in-White) welding lines.

Industrial Automation Application in Conveyor Systems

Conveyor systems form the backbone of material handling in automotive manufacturing. They ensure the seamless movement of parts and components across various production stages. With the evolution of automation, conveyor systems have transitioned from basic mechanical belts to smart, IoT-enabled systems that enhance operational efficiency and adaptability.

Historical Development: Earlier conveyor systems were mechanical and required manual oversight for operation. Over the time, advancements in motor technology and control systems introduced automation to conveyors, enabling continuous and precise movement of materials. The incorporation of sensors and PLCs further streamlined operations, reducing human intervention.

Modern Applications: Today's automated conveyor lines are equipped with IoT devices that provide real-time tracking and diagnostics. They are designed to handle diverse materials with minimal downtime. In automotive plants, these conveyors facilitate just-in-time (JIT) production by synchronizing with other automated systems, ensuring optimal workflow, and reducing inventory costs.

Industrial Automation Application in Assembly Lines

Assembly lines have undergone significant automation to meet the high demands of the automotive sector. Automation in assembly lines ensures consistency, speed, and precision, enabling manufacturers to produce high-quality vehicles efficiently.

Historical Development: The concept of assembly lines revolutionized production with Henry Ford's moving assembly line. Initially, these lines relied heavily on manual labour, with workers performing repetitive tasks. The integration of automation began with mechanized systems and evolved to include robots and AI-driven systems.

Modern Applications: Automated assembly lines now use robotic arms, vision systems, and AI algorithms to perform tasks such as component fitting, quality inspection, and error detection. These systems are particularly effective in tasks requiring high precision, such as engine assembly and electronic component installation. Collaborative robots (cobots) are also being used to work alongside humans, enhancing efficiency and reducing workplace injuries.

Industrial Automation Application in Special Purpose Machinery

Special-purpose machinery (SPM) caters to the unique requirements of automotive manufacturing. These machines are designed for specific tasks, such as machining, testing, and packaging, and play a critical role in enhancing production efficiency and quality.

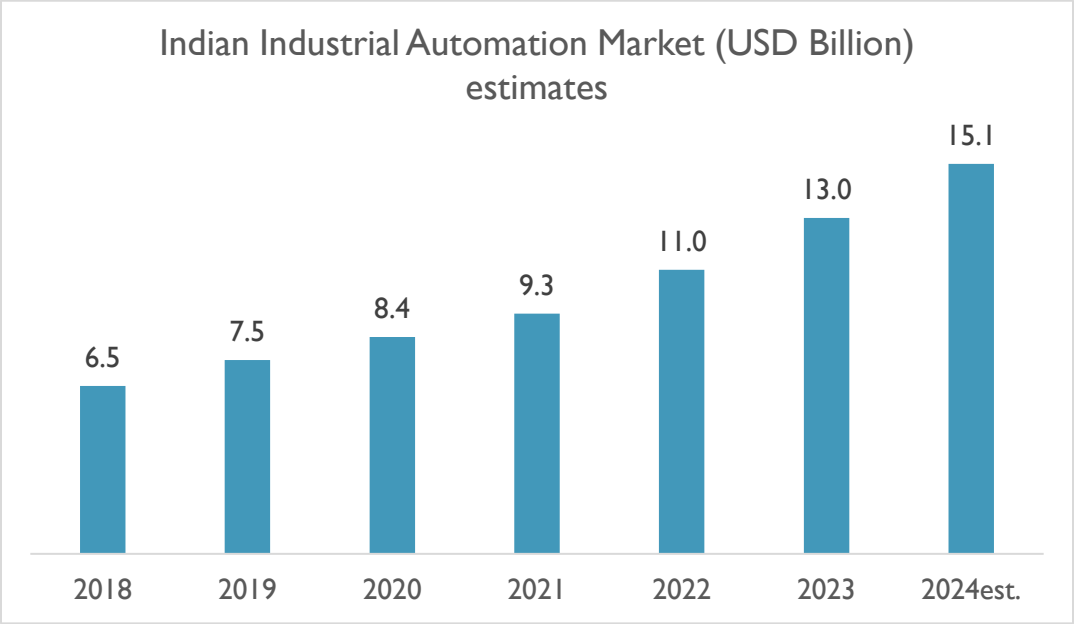
Historical Development: SPMs have evolved from manually operated equipment to highly sophisticated automated systems. Early machines were mechanical and required significant human intervention. The introduction of CNC and PLC technologies in the 1970s marked the beginning of automation in SPMs.

Modern Applications: Today's SPMs are integrated with robotics, IoT, and AI to perform complex tasks with minimal human involvement. For example, automated testing machines are used to inspect components for defects, while robotic cells are employed for machining intricate parts. These systems offer benefits such as reduced cycle times, improved accuracy, and lower operational costs.

Industrial automation continues to evolve, with advancements in AI, machine learning, and digital twins poised to redefine the automotive manufacturing landscape. These technologies promise even greater levels of efficiency, customization, and sustainability, ensuring the sector remains at the forefront of industrial innovation.

Market turnover growth of the Indian Industrial automation solutions industry

Indian manufacturing sector is steadily embracing transforming technologies and automation. The current Government is increasing its focus on manufacturing, through the launch of flagship programs like Make in India, to increase the share of manufacturing GDP. This has entailed huge investment in terms of technology upgradation as well as automation.



Sources: Dun & Bradstreet Desk Research [3]

[3] Based insight published by leading Market Research agencies.

The Indian industrial automation market experienced a steady growth from 2018 to 2023, driven by the increasing adoption of advanced technologies across manufacturing sectors. Starting at approximately USD 6.5 billion in 2018, the market grew to USD 13 billion in 2023, reflecting a CAGR of around 15%. This growth was fueled by rising demand for efficiency, precision, and scalability in manufacturing processes, alongside government initiatives like *Make in India* that encouraged technology-driven investments. Despite challenges such as the global pandemic, the industry demonstrated resilience, with accelerated adoption of automation solutions post-2020 to address labor shortages and enhance productivity.

The growth in Industrial Automation Equipment's appears to be robust in India. The increasing focus on the Government to improve the manufacturing infrastructure in India, through the flagship Make in India program, Industry 4.0 and most recently PLI scheme and Atma Nirbhar is playing a pivotal role. The regulatory changes and policy measures that are being implemented as part of the program are attracting multinational companies.

Key Demand Drivers

The manufacturing sector is undergoing a transition, as the industry shift to the new Industry 4.0 norm. Dubbed the new industry revolution, the focus here is on improving efficiency as well as pace of activity. Automation of process has become central to this new norm. Factory automation which utilizes welding, automated assembly line and robotic solution is the hallmark of Industry 4.0. This shift has resulted in higher demand for industrial robots, data collection & analysis tools, as well as other smart industry platforms.

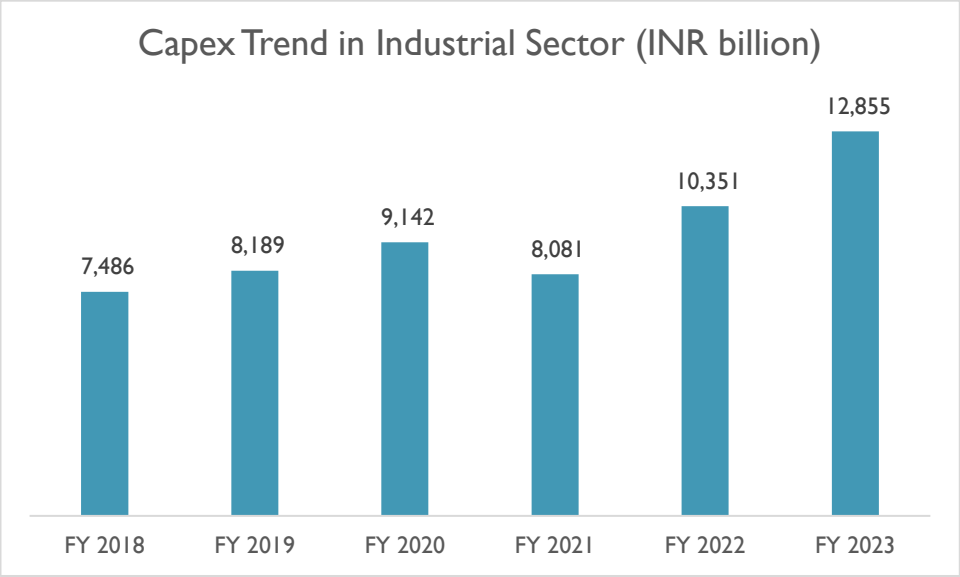
In a bid to become competitive and be on par with global peers, industrial sector in India is witnessing an increasing focus on operational optimization and cost control. Process control and automation helps in identifying areas of improvement as it measures and controls manufacturing processes. With growing manpower costs, the focus on operational optimization has increased leading to a demand growth of various automation including assembly line automation and welding automation. Robust economic growth during a major part of the past decade has resulted in increased pace of growth in industrialization.

The Indian industrial automation industry is driven by several key factors, which are propelling growth and adoption across various sectors:

Manufacturing Sector Growth:

The Indian government's "Make in India" initiative aims to boost local manufacturing, making it a strong driver for automation. Industries like automotive, electronics, and consumer goods are increasingly adopting automated systems to meet production demands, enhance productivity, and maintain quality

standards. The capex in industrial sector[4] measured in terms of GFCF has observed 11% CAGR growth, increasing from INR 7,486 billion to INR 12,855 billion.



Sources: National Account Statistic 2024

The China Plus One strategy is an approach adopted by companies and countries to diversify their supply chains away from excessive reliance on China as a manufacturing and sourcing hub. The strategy emerged as a response to various factors, including rising labour costs in China, geopolitical tensions, trade uncertainties, and the need to mitigate risks associated with being overly dependent on a single country for production and sourcing. India, being one of the largest economies in the world and home to a vast workforce and diverse manufacturing capabilities, has been actively leveraging the China Plus One strategy to attract investments and businesses looking to diversify their supply chains away from China.

Labor Cost and Availability: Rising labor costs and a skilled labor shortage for repetitive or hazardous jobs are prompting industries to consider automation as a cost-effective and efficient solution. Automation ensures consistent performance without the fluctuations that can arise from human labor availability.

Technological Advancements in Automation: The integration of advanced technologies, including automation and Industry 4.0 initiatives, is revolutionizing India's manufacturing landscape. As companies increasingly adopt these technologies to enhance production efficiency, there is a pressing need for modern production facilities that can support sophisticated processes. With the advent of Industry 4.0, new technologies such as the Industrial Internet of Things (IIoT), artificial intelligence, robotics, and data analytics are becoming more accessible and affordable. These technologies enable better process

[4] GFCF in manufacturing taken as a proxy to reflect industrial sector construction.

optimization, predictive maintenance, and real-time monitoring, attracting investments in automation. This shift necessitates substantial investments in upgrading existing infrastructure and developing new industrial spaces, that cater to the needs of high-tech manufacturing operations.

Quality and Safety Requirements: Stringent quality standards and the need for workplace safety encourage industries to adopt automation solutions. Automated systems ensure consistent product quality and minimize human involvement in dangerous environments, thus reducing workplace accidents.

Energy Efficiency and Sustainability: Automation allows for more efficient energy management and resource optimization. In industries such as manufacturing, energy consumption can be monitored and reduced through automation, aligning with sustainable practices, and helping companies meet their energy efficiency targets.

Rapid Urbanization and Infrastructure Development: Infrastructure growth, especially in construction, transport, and smart cities, is increasing the demand for automated machinery and robotics to speed up projects and improve safety. Automated systems and equipment are vital to support the scale of operations needed for large infrastructure projects. Infrastructure Development: The Indian government's massive investments in infrastructure, including highways, ports, railways, and power grids, create an enabling environment for industrial growth. Improved logistics and connectivity enhance the operational efficiency of industrial zones, making them more attractive to businesses. As these infrastructure developments progress, they lead to increased demand for new manufacturing units and warehouses, driving a corresponding rise in automation solution that supports its operation.

Demand for High-Quality, Customized Products: With the rise in disposable income and changing consumer preferences, there is an increased demand for high-quality, customized goods. Automation in production lines helps meet this demand by allowing for mass customization without compromising efficiency.

Foreign Investments and Strategic Partnerships: Increased foreign direct investments and partnerships with international automation companies bring in advanced automation solutions. Multinational corporations often have global automation standards and bring their expertise to Indian operations, driving automation adoption.

Rising Domestic Consumption: The growth of India's middle class, which is expected to reach 580 million by 2025, is significantly driving domestic consumption. With rising disposable incomes, there is an increasing demand for a variety of consumer goods, compelling manufacturers to enhance their production capabilities. As a result, businesses are investing heavily in new factories and industrial facilities to meet this demand.

Government Policies and Initiatives: Indian government initiatives such as Digital India and the National Policy on Advanced Manufacturing, Production linked incentives encourage companies to adopt automation. These policies aim to enhance the country's technological capabilities and support digital transformation across industries.

Production Linked Incentive Scheme (PLI): The Production Linked Incentive Scheme represents a strategic commitment by the Indian government, with an outlay of INR 1.97 trillion (over USD 26 billion) announced in the Union Budget 2021-22 for 14 key manufacturing sectors. This financial support incentivizes companies to increase production levels, particularly in sectors like electronics, pharmaceuticals, and automobiles. By attracting global players and stimulating domestic production, the PLI scheme significantly drives the demand for industrial construction, as businesses invest in building or upgrading manufacturing facilities to qualify for these incentives.

Skill Development Programs: Initiatives like "Skill India" and "Make in India Skill Development Centers" are crucial for addressing skill gaps in the workforce. These programs aim to train millions of individuals in various technical skills necessary for modern manufacturing processes. By ensuring a steady supply of skilled labor, these initiatives facilitate the establishment of new industrial units, which, in turn, generates increased demand for industrial construction to accommodate the growth of these facilities and ensure they are staffed with qualified personnel.

Business-Friendly Reforms: The Indian government has implemented numerous reforms since 2014 aimed at simplifying regulations and reducing bureaucratic hurdles, making it easier for companies to establish and operate in India. The ease of doing business has improved significantly, as evidenced by India's rise in the World Bank's Ease of Doing Business rankings. This pro-business environment attracts both domestic and international investments, leading to an increase in industrial projects as firms seek to capitalize on favorable conditions for growth.

Growth Drivers in Automotive Sector Automation:

Nowadays, automotive OEMs (Original Equipment Manufacturers) and Tier 1 suppliers are looking for efficient and reliable production methods that is driving the demand for turnkey automation solutions. The rapid growth of automation solutions in the automotive sector is fueled by several key drivers:

Cost Reduction & enhanced precision, efficiency, and productivity: Automated system including Automated systems, including robotic welding lines and assembly lines reduces operational costs by enhancing production speed, minimizing material waste, and lowering labor expenses. Advanced robotics

and AI systems ensure precision and consistency, further driving down costs associated with errors and rework.

Increasing Demand for Electric Vehicles (EVs): The shift towards electric vehicles is a significant growth driver for automation. EV manufacturing demands high precision and the ability to handle specialized components such as batteries and electronic control units. Automation technologies, including robotic assembly and smart material handling systems, are pivotal in meeting these requirements. As EV adoption grows, the demand for automation solutions in battery production and vehicle assembly will surge.

Quality Control and Safety Standard: Consistent product quality and safety standard are critical aspect for automotive manufacturers who deal with high volumes and stringent regulatory requirements which can be achieved through automation. Usage of robots and automated machinery allows for enhanced safety during the production process by performing hazardous tasks, such as welding, heavy lifting, and working in high-temperature environments.

Technology Advancement: Innovations in AI, IoT, and robotics are transforming automotive manufacturing. Industry 4.0 principles, such as real-time data analytics and predictive maintenance, are enabling manufacturers to optimize production processes and improve decision-making. The adoption of Industry 4.0 technologies is revolutionizing manufacturing. Smart factories, equipped with interconnected systems, leverage real-time data to enhance productivity, reduce downtime, and improve quality control. Automation plays a central role in this transformation, enabling seamless integration of production processes.

Labor Shortages: The automotive sector faces labor shortages due to aging workforces and the decline in interest in repetitive factory jobs. Automation provides a solution by reducing reliance on manual labor and ensuring uninterrupted production.

EV-Specific Automation Needs in the Automotive Automation Market

The rise of electric vehicles (EVs) has profoundly reshaped the dynamics of the automotive automation market. EV manufacturing introduces unique requirements that demand specialized automation solutions across various production stages. Below are key areas where EV-specific needs are driving advancements in industrial automation:

Battery Manufacturing and Assembly:

- Automation systems are critical for handling the complexity and precision required in battery manufacturing.
- Processes such as cell stacking, module assembly, and battery pack integration are automated to ensure consistency, minimize defects, and meet safety standards.
- Advanced robotics and AI-driven systems optimize battery assembly efficiency and scalability.

Electric Drivetrain Production:

- Unlike traditional internal combustion engines, EVs rely on electric drivetrains. Automation plays a vital role in manufacturing components like motors, inverters, and power electronics.
- Precision machining, robotic assembly, and automated quality checks ensure reliability and performance of these critical components.

Lightweight Material Handling:

- EV manufacturers increasingly adopt lightweight materials, such as aluminum and composites, to improve energy efficiency.
- Automated systems are used for handling and assembling these materials, which are often more delicate than traditional metals.

Thermal Management Systems:

- EVs require effective thermal management for batteries and power electronics. Automation ensures precise manufacturing and integration of cooling systems, which is essential for vehicle performance and longevity.

Scalability and Modular Production:

- The rapid growth in EV demand has necessitated scalable production solutions. Modular automation systems enable manufacturers to adjust production capacity flexibly, ensuring responsiveness to market changes.

End-of-Line Testing and Inspection:

- Automated testing systems validate the performance and safety of EV components, such as batteries, motors, and electronic control units (ECUs).
- Machine vision and AI-based systems are used for real-time quality inspections to meet stringent industry standards.

Integration of Industry 4.0 Technologies:

- EV manufacturing processes are heavily reliant on data-driven decision-making and real-time monitoring.
- IoT-enabled automation systems and digital twins provide insights into production efficiency, predictive maintenance, and supply chain optimization.

Technological Advancements and Innovation in Industrial Automation Sector

The Indian industrial automation sector is experiencing significant technological advancements and innovations, propelling the industry toward enhanced efficiency, productivity, and global competitiveness. Key development includes:

Industry 4.0 Integration

Smart Manufacturing: Globally, the manufacturing sector is entering the next phase of growth, dubbed as Industry 4.0. Also referred to as the "Fourth Industrial Revolution", Industry 4.0 emphasizes the integration of digital technologies such as IoT, AI, and robotics to create interconnected, intelligent manufacturing systems. This approach enables real-time data collection, remote monitoring, and enhanced decision-making.

These advances have made today's Smart Factories, powered by Industry 4.0, to react to market changes on a real-time basis, without the time lag that existing previously. Also, with rapid changes in business sentiment, consumer demand, and competition, companies are focusing on predictive aspects to keep one step ahead. Additionally, the availability of real-time data from all aspects of manufacturing coupled with real-time analysis has improved the scope of efficiency improvement and cost optimization.

Cyber-Physical Systems (CPS): With CPS, physical processes are tightly integrated with computational resources, allowing for autonomous operations and self-optimization of machinery. This trend is central to achieving smart factories in India.

Integration of Artificial Intelligence (AI) and Machine Learning (ML): AI and ML are being incorporated into automation systems to enable predictive maintenance, optimize production processes, and facilitate real-time decision-making. These technologies help in analyzing vast datasets to identify patterns and anomalies, thereby improving operational efficiency.

- *Quality Control and Defect Detection*: AI-powered image processing and machine vision systems enhance quality control by identifying defects on production lines in real time.
- *Process Optimization:* AI and ML algorithms analyze vast data sets to identify process inefficiencies, enabling companies to make data-driven adjustments that maximize productivity.

Implementation of Robotics and Automation: The use of industrial robots is on the rise, particularly in sectors like automotive, electronics, and pharmaceuticals. Robots are employed for tasks ranging from assembly and welding to packaging and quality inspection, ensuring precision and consistency.

Emphasis on Energy Efficiency and Sustainability: Automation solutions are increasingly focusing on energy-efficient operations and sustainable practices. Innovations include the development of energy-saving drives, efficient motors, and systems designed to minimize environmental impact.

Growth of Additive Manufacturing (3D Printing): Additive manufacturing is gaining traction in India, allowing for rapid prototyping and production of complex components. This technology reduces material waste and shortens the product development cycle.

Expansion of Cloud Computing and Data Analytics: Cloud-based platforms are being utilized for data storage and analytics, providing scalable solutions for managing large volumes of industrial data. This facilitates better resource planning and informed decision-making.

Enhancement of Human-Machine Interfaces (HMIs): Modern HMIs are becoming more intuitive and user-friendly, incorporating touchscreens and graphical displays. These interfaces improve operator interaction with machinery, leading to increased productivity and safety.

Industry 5.0: Transforming the Manufacturing Landscape

Industry 5.0 is all set to take the stage when Industry 4.0 is still gaining popularity and yet to get matured. It is transforming the way manufacturing industry functions. Factors like increased efficiency, shorter turnaround time, higher productivity, and superior quality products form the core of this movement.

Industry 5.0 is regarded as a fifth industrial revolution envisions an industry that functions with the combined power of humans and machines and contributes to society while adhering to the limits of the planet. Most of the technological innovations and concepts of Industrial Revolution 5.0 are derived from

Industry 4.0. The fifth industrial revolution will pave the way for a sustainable, resilient, and human-centered approach to manufacturing.

Adoption of the Industrial Internet of Things (IIoT): The IIoT connects machinery and equipment through the internet, allowing seamless communication and data exchange. This connectivity enables remote monitoring, control, and analysis of industrial processes, leading to reduced downtime and enhanced productivity.

- Connected Devices: To advent of industrial automation, connected machines, usage of real time sensors along with data analysis capability, and Industrial Internet of Things (IIoT) is in line with these factors. The usage of industrial robots, autonomous systems for material handling, connected supply chains, and additive manufacturing is changing the face of manufacturing. Although the repetitive tasks are done by robots in industry 4.0 which is at the mass customization level, industry 5.0 aims to perform mass personalization with help of Artificial Intelligence. Industry 5.0 is expected to revolutionize the production process with higher autonomy to collaborative robots. Industry 5.0 is the futuristic industrial revolution which is expected to bring in more creativity and innovation in the products by allowing robots to perform repetitive tasks.

  With the IIoT, industrial devices are equipped with sensors, enabling communication and data exchange. This connectivity allows for continuous monitoring and remote diagnostics, improving operational visibility.

- Real-Time Monitoring and Control: IIoT allows for real-time tracking of processes, enabling quick response to issues and efficient resource allocation. This trend is essential for sectors that require high precision, such as pharmaceuticals and electronics.

Digital Transformation

- Cloud Computing and Edge Computing: Automation is increasingly leveraging cloud and edge computing for data storage, analysis, and process optimization. Cloud computing enables central management of data, while edge computing brings computational power closer to machines, enabling faster processing.

- Data Analytics and Predictive Maintenance: Real-time data analytics is transforming operational efficiencies. Predictive maintenance uses analytics to foresee equipment failures, allowing proactive maintenance and reducing downtime.

Rise of Collaborative Robots (Cobots)

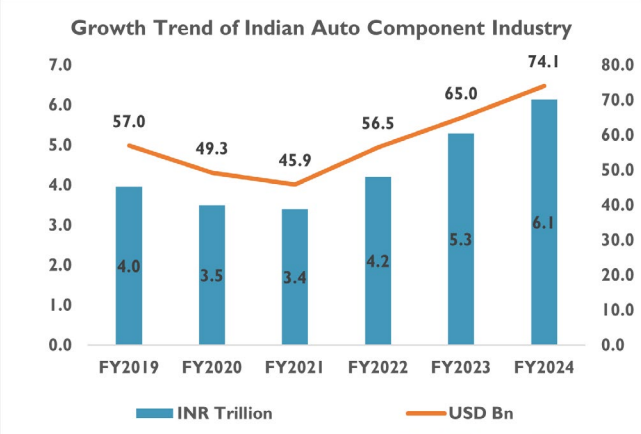
- Human-Robot Collaboration: Cobots are designed to work safely alongside humans, enhancing productivity without compromising safety. Cobots are increasingly adopted in small to medium enterprises (SMEs) for tasks that require flexibility.
- Labor Efficiency: The shortage of skilled labor has increased the demand for cobots in various industries, including automotive and consumer goods, to automate repetitive or physically demanding tasks.

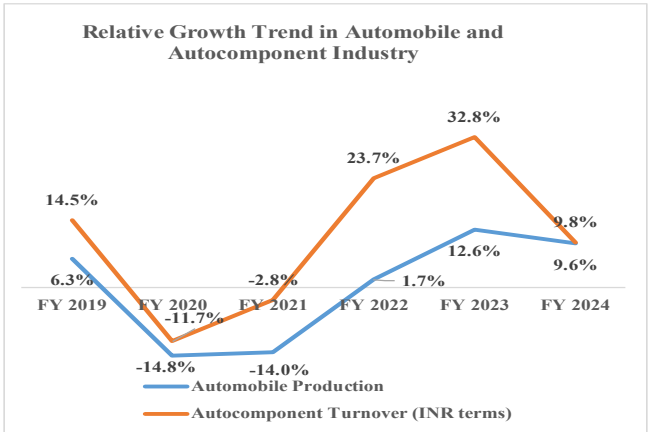
Emphasis on Cybersecurity for Automation Systems

- Protecting Connected Systems: As factories become more connected, cybersecurity has become essential to protect sensitive data and ensure uninterrupted operations. Security measures like firewall protections, encryption, and network segmentation are now standard in automation setups.
- Compliance and Standards: Adherence to cybersecurity standards, especially for critical industries like defense and healthcare, is vital to safeguard automated operations from cyber threats.
- Government Initiatives and Support: The Indian government is promoting automation through policies like the Production Linked Incentive (PLI) scheme and the Make in India initiative. These programs encourage domestic manufacturing and the adoption of advanced technologies.

Performance review of Indian Auto component & Automobile Sector

Backed by recovering demand, as per Automobile Component Manufacturers Association of India (ACMA), the turnover in Indian auto component industry increased to USD 74.1 Bn (INR 6.14 trillion) in FY 2024, growing by 9.8% y-o-y due to recovery in vehicle sales owing to improved consumer demand. This includes supplies to OEMs, aftermarket, and exports in respective share of 84%, 15% and 29%. The industry clocked highest turnover in the last 5 years.

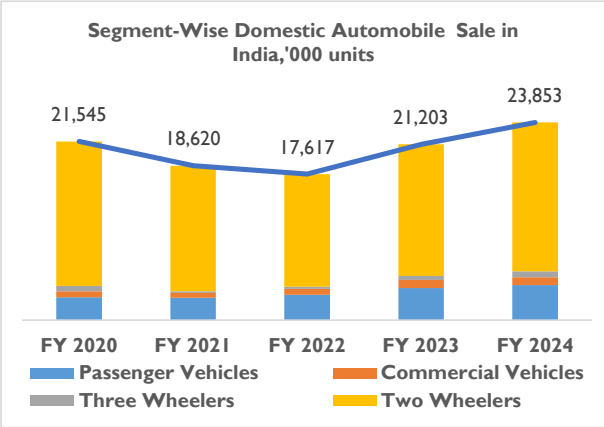


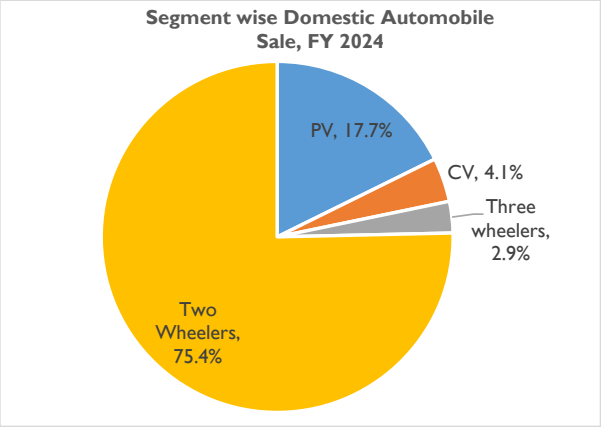


Sources: ACMA

Automobile Industry Performance

Post covid, signs of recovery began to emerge in FY 2022 with production reaching 23.0 million units, and this upward trend continued through FY 2024 with production rising to 28.4 million units. However, production levels have not yet surpassed the pre-pandemic peak of 30.9 million units recorded in FY 2019.





Source: Dun & Bradstreet Research, Society of Indian Automobile Manufacturers (SIAM)

Note: Segment-wise summation of domestic sales will not add to 100% total as Quadricycle data has not been included for analysis purpose

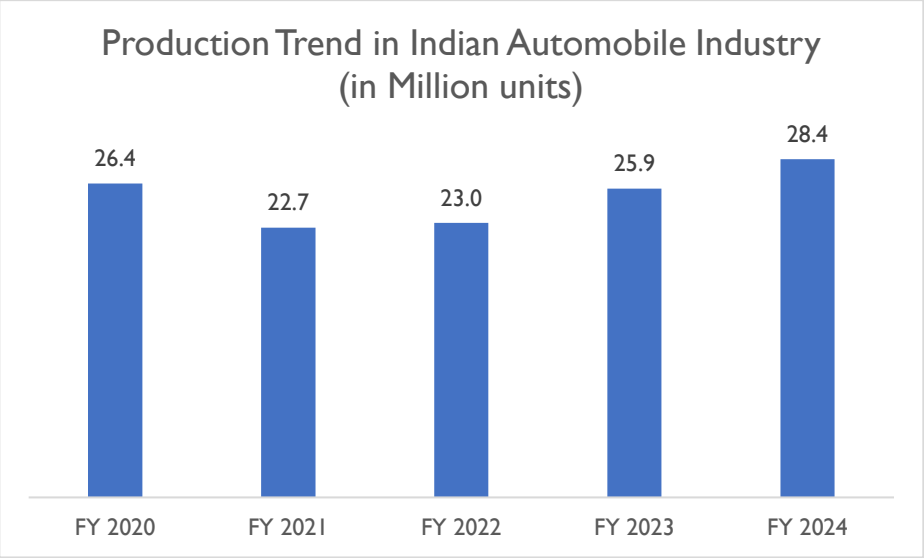
Segment Wise Sales	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Passenger Vehicles	2,774	2,711	3,070	3,890	4,219
Commercial Vehicles	718	569	717	962	968
Three Wheelers	637	219	261	489	692
Two Wheelers	17416	15121	13570	15862	17,974
Total	**21,545**	**18,620**	**17,617**	**21,203**	**23,853**

Sources: SIAM

Source: Dun & Bradstreet Research, Society of Indian Automobile Manufacturer

Overall domestic sales grew to 23.8 million units in FY 2024, registering y-o-y growth of 12.5% y-o-y growth in FY 2024 whereas PV sale grew to all time high in FY 2024 and it observed 8.45% y-o-y growth. Multiple factors such as growing middle class, an increase in disposable incomes and a low penetration ratio have been fueling the growth of Passenger Vehicle in India. India's car penetration ratio stood at 24 per 1,000 people, which compares poorly with the world average of 314, in 2022. It is the third lowest among the top 13 markets, according to World Road Statistics 2023 International Road Federation.

On supply side, improved vehicle availability, launch of new models, strong demand in the SUV segment, strategic marketing efforts and exciting model mix played pivotal roles in shaping the demand landscape. Additionally, improving road infrastructure also contributed towards rising auto sales including PV sales. During the last 5 years, overall automobile sales has observed 3% CAGR increase while PV sales have observed 11% CAGR between FY 2020-24.



Source: Society of Indian Automobile Manufacturers (SIAM)

Post covid, signs of recovery began to emerge in FY 2022 with production reaching 23.0 million units, and this upward trend continued through FY 2024 with production rising to 28.4 million units. However, production levels have not yet surpassed the pre-pandemic peak of 30.9 million units recorded in FY 2019.

YTD FY 2025

In October 2024, the Indian auto industry reached new sales highs across the Passenger and Two-Wheeler segments, driven by the festive boost of Dussehra and Diwali occurring in the same month. According to SIAM, Passenger Vehicles recorded their highest-ever October sales with 393,238 units, reflecting a modest 0.9% growth over October 2023, despite a high comparative base. The Two-Wheeler segment also posted a record with 2,164,276 units sold, a 14.2% rise over the previous year, supported by a 30% increase in Vahan vehicle registrations. However, Three-Wheelers saw a minor decline of 0.7% compared to October 2023, with sales at 76,770 units, although a registration growth of 11% suggests sustained demand.

Earlier in April 2024, the industry had shown promising growth as the fiscal year began, with all segments reporting increases over the previous year. Domestic Passenger Vehicle sales reached 335,629 units, marking a slight growth of 1.3% over April 2023, while Two-Wheelers saw a substantial rise of 30.8%, with 1,751,393 units sold. The Three-Wheeler segment also recorded a positive trend, with a 14.5% growth at 49,116 units sold. Positive consumer sentiment, festive demand, and favorable economic factors, including policy stability and infrastructure development initiatives, contributed to the industry's strong performance.

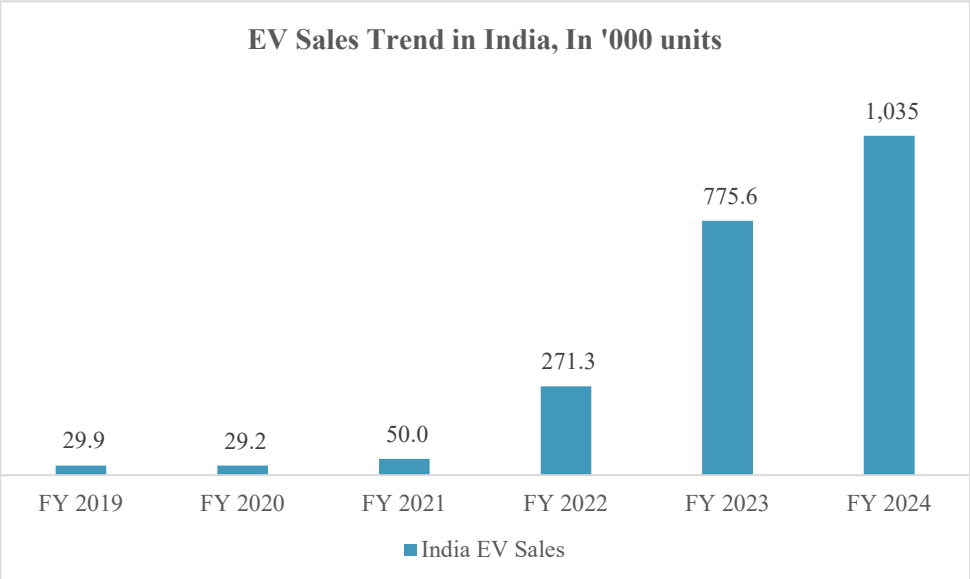
Production levels followed similar trends, with October witnessing a high output of 2,882,996 units across Passenger Vehicles, Three-Wheelers, Two-Wheelers, and Quadricycles, compared to 2,358,041 units in April 2024. This steady production growth aligns with increasing market demand and higher consumer confidence, reflecting a robust start to FY 2024-25 and solid performance into the festive season.

Transforming Automobile Landscape

Increasing fuel price and concerns about emission related pollution have increased the interest for electric vehicles among consumers. In the recent years, electric vehicle industry has witnessed rapid technological changes which has brought down the price substantially. Although still priced higher than conventional Internal Combustion Engine (ICE) vehicles, the price gap has come down. Together, these factors have created a market for electric vehicle, which although in infancy has the potential to grow exponentially.

Like two-wheeler and three-wheeler segment, the PV segment is also witnessing a steady transformation toward EV primarily due to sharp surge in petrol and diesel price which are weighing heavy on retail consumers. While improving EV ecosystem in terms of charging infrastructure, battery technology development to support high speed and long-range travel, battery swapping is helpful in gradually alleviating consumers anxiety towards migrating to EV.

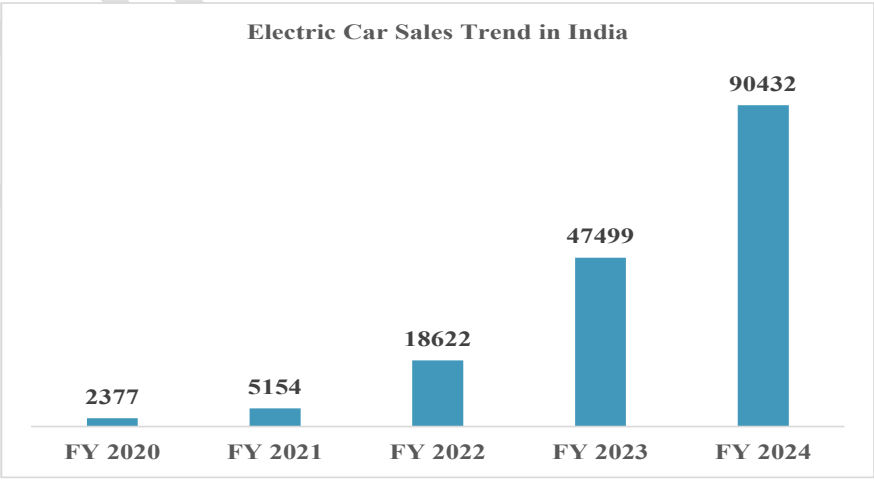
Consolidated sales of EVs (e-2W and e-4W) were 1,035 thousand unit in FY 2024, surging by 33.4% against 185.9% increase over the previous year. The rate of increase was sharp in FY 2023 due to lower volume level.



Society of Manufacturers of Electric Vehicles (SMEV), e-2W & e-4W

India's electric mobility program is driven by Government backed demand initiative model, which is at the core of the flagship Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME). The Union Government has set a target of converting 30% of vehicle fleet to electric by 2030, which is amongst the most aggressive plans that are being implemented across the globe. This aggressive policy framework has created a small but fast-growing EV industry in India, which is currently dominated by electric two wheelers.

With an annual e-4W sale of over 90 thousand units (in FY 2024), the **passenger car industry** in India is transforming. The pace of growth it has achieved in the 5 years is tremendous, pointing towards huge opportunity. From nearly 2,000 units per annum in FY 2020, electric car sales jumped to 90,431 units in FY 2024, a compounded annual growth rate of 148%.



Society of Manufacturers of Electric Vehicles (SMEV), * till 14th March

EV sales in India are aggressively pushed by government support. Policies such as Automobile Mission Plan 2016-26 Phase-II, Faster Adoption & Manufacturing of Electric Hybrid Vehicles (FAME) Scheme (I & II) and most recently introduced the PLI scheme for automobile and auto components are likely to have a favorable impact on overall industry performance with deeper penetration of EV in the overall fleet volume.

The share of EVs in total registered vehicle continued to grow strong to 6.3% in 2023 from below 1% (0.7%) in 2020. The increasing surge in EV sale since June is largely attributed to the pent-up demand from the second wave slowdown which got triggered due to revised FAME subsidies, high fuel prices and launch of new electric vehicles along with improved charging infrastructure.

With a strong portfolio and strategic tie-up with Uber, Tata Motors accounted for majority share in EV sales. In 2023, the domestic EV market was dominated by Tata Motors (72%), followed by MG Motors (10.8%) and Mahindra (9%), with the top selling models being Tiago, Nexon and Tigor from Tata Motors, the MG ZS, and Mahindra XUV400.

YTD EV Segment Sales Growth Trend (Apr-Oct 2024)

Segment	7M FY 2024	7M FY 2025	Y-o-Y Change
E-2 Wheelers	475,167	590,652	24%
E-3 Wheelers	356,222	378,394	6%
E-4 Wheelers	50,487	49,306	-2%
E-Buses	1,981	1,981	0%
Total Sales	883,857	1,020,333	15%

Note, This data as on 22nd October. It excludes Telangana. This data does not include Low Speed Sales

Sources, SMEV

YTD sales EV sales during FY 2025 observed 15% y-o-y growth over the corresponding period last year with two-wheeler contributing significantly to driving the total EV sale followed by electronic three-wheeler segment while e-4 wheeler segment observed some contraction during the period taken under consideration.

Growth Drivers

The Indian automobile industry has experienced significant growth, driven by several key factors:

Economic Growth	• Excluding the Pandemic years (FY2020-21), India's GDP is growing at 7-7.5% rate annually since FY 2014 favouring growth in consumption and investment demand.
Income Growth	• The country's Per capita income has increased from INR 68,572 in FY 2014 to INR 86,668 in FY 2023, registering a CAGR of 4.1% in the last 10 years.
Access To Large Market	• With over 1.42 Bn population, India emerged as the world most populous country in April' 23. India's population is projected to reach 1.54 Bn by 2032.
Demographics Advantage	• More than two-thirds of its population or 68% comprises people between the ages of 15 and 64 while with a median age of 31 by 2030, India will remain one of the youngest nations in the world.
Urbanisation	• The share of Urban population to total population in India grew from 27.8% to 31% between 2001-2011 and is further estimated to grow to 41.7% by 2030.
Per Capita Consumption	• Rural per capita consumption to grow 4.3 times by 2030, compared to 3.5 times in urban India
Rising Consumerisim	• India's consumption expenditure to grow from USD 1.5 trillion in 2021 to USD 6 Trillion by 2030 backed by the 370 Mn aspirational consumer age between 0-25 who will have grown up in India which have relatively better digital reach than before.
Increasing Millennial Population	• By 2030, India will have nearly 90 Mn new households headed by millennials
Affluent and Elite to drive spending	• India's affluent population and elite population is expected to grow by 2.1 X and 2.3X between 2019-2030
Digital Economy Growth	• India's digital economy is expected to reach USD 1 Tn by 2030 from USD 90 Bn
Internet User Growth	• India has second largest Internet users base which reached 751.5 Mn as on 28rd Feb 2024.
Increase in Digital Payment	• Digital payments gross transaction value is expected to grow from USD 0.6 Tn in 2022 to USD 3.1 Tn (2030)
Government Spending on Road Infrastructure	• Increasing Government spending towards steady improvement in Road Infrastructure

Rising Income Levels: India's per capita Net National Income (NNI) increased by 46.61% from INR 72,805 in 2014-15 to INR 106,744 in 2023-24, enhancing consumers' purchasing power and boosting demand for vehicles.

Urbanization: Rapid urbanization has led to increased demand for personal and public transportation. The urbanization rate was estimated at 33.2% of India's population and is expected to reach 36.2% by 2025, necessitating more vehicles.

Government Initiatives: Policies like the Automotive Mission Plan 2026 and the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme have provided incentives and a supportive framework for industry growth.

Infrastructure Development: Investments in road networks and transportation infrastructure have improved connectivity, facilitating the movement of goods and people, thereby increasing vehicle demand.

Availability of Financing: The ease of obtaining vehicle loans and financing options has made vehicle ownership more accessible to a broader segment of the population.

Technological Advancements: The integration of advanced technologies, such as electric mobility and connected vehicle features, has attracted consumers seeking modern and efficient vehicles. By 2030, the Indian government has committed that 30% of the new vehicle sales in India would be electric.

Export Opportunities: India's emergence as a global manufacturing hub has led to increased automobile exports, contributing to industry growth. India's automobile industry has demonstrated robust growth in exports, with a 14% year-on-year increase in the first half of the fiscal year 2025 (April-September 2024), totaling 2,528,248 units.[5]

Government Initiatives

The Indian government has implemented several initiatives to bolster the automobile industry, focusing on growth, sustainability, and technological advancement. Key initiatives include:

Production Linked Incentive (PLI) Scheme for Automobile and Auto Components

Launched to enhance domestic manufacturing of advanced automotive technology products, the PLI scheme offers financial incentives to manufacturers based on their incremental sales. This initiative aims to attract investments and promote the production of EVs and hydrogen fuel cell vehicles.

Union Cabinet approved the PLI-Auto Scheme on 15.09.2021 with budgetary outlay of INR 25,938 crore for a period of 5 years (FY2022-23 to FY2026-27). The PLI-AUTO Scheme will boost manufacturing of Advanced Automotive Technology (AAT) Products.[6] The PLI scheme, which spans from FY23 to FY27,

[5] https://www.autocarpro.in/analysis-sales/vehicle-exports-from-india-rise-14-in-h1-fy2025-cars-2-wheelers-and-cvs-drive-revival-123151
[6] https://heavyindustries.gov.in/pli-scheme-automobile-and-auto-component-industry

has a budgetary outlay of INR 25,938 crore. As of March 2024, capital investment under the scheme has reached INR 14,043 crore.[7]

Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) India Scheme

Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India (FAME India) Scheme-I was launched in the year 2015 to promote hybrid and EV technologies in India. Under FAME-I, a total 2.8 lakh vehicles were supported. Phase-II was being implemented by the Ministry of Heavy Industries for a period of five years commencing from 1st April,2019 with a total budgetary support of INR 10,000 crore. The FAME scheme, now in its second phase, provides incentives for the adoption of electric and hybrid vehicles. It focuses on establishing charging infrastructure and promoting EVs in public transportation, thereby reducing dependency on fossil fuels and lowering vehicular emissions. The FAME Scheme was extended for a further period of 2 years up to March 31st, 2024.

In its Budget, the government has proposed an allocation of INR 2,671.33 crore under the FAME scheme for 2024-25. While the budget estimate was INR 5,171.97 crore for the 2023-24 fiscal, the revised estimate turned out to be INR 4,807.40 crore.

Automotive Mission Plan 2026

The Automotive Mission Plan 2016-26 (AMP 2026), a collaborative initiative between the Government of India and the Indian automotive industry, aims to position India among the top three global leaders in automotive engineering. The AMP aims to make the Indian Automotive Industry, a significant contributor to the "Skill India" programme. The plan's objectives include:

- The industry is expected to grow 3.5-4 times in value by 2026.
- The industry's contribution to GDP is expected to increase to over 12% and create 65 million new jobs.

Bharat Stage VI (BS-VI) Emission Norms

BS-VI norms are stringent emission standards that align with global benchmarks. The transition from BS-IV to BS-VI was expedited to reduce harmful emissions and promote cleaner technologies in vehicle manufacturing. With BS-VI fuel, a car will emit 80% less particulate matter (PM) and nearly 70% less nitrogen oxide per kilometer in a diesel engine. In a petrol engine, nitrogen oxide emissions will be reduced by 25%.

[7] https://www.cnbctv18.com/auto/budget-2024-pli-scheme-for-automobile-and-auto-components-sector-allocation-19447099.htm

Vehicle Scrappage Policy

India's Vehicle Scrappage Policy, introduced in 2021, aims to phase out old, unfit, and polluting vehicles to promote environmental sustainability and enhance road safety. The policy mandates that commercial vehicles over 15 years old and private vehicles over 20 years old undergo mandatory fitness tests. Vehicles failing these tests are deemed unfit for road use and are required to be scrapped. As of July 15, 2024, a total of 96,980 vehicles have been scrapped by Registered Vehicle Scrapping Facilities.[8]

Growth Outlook

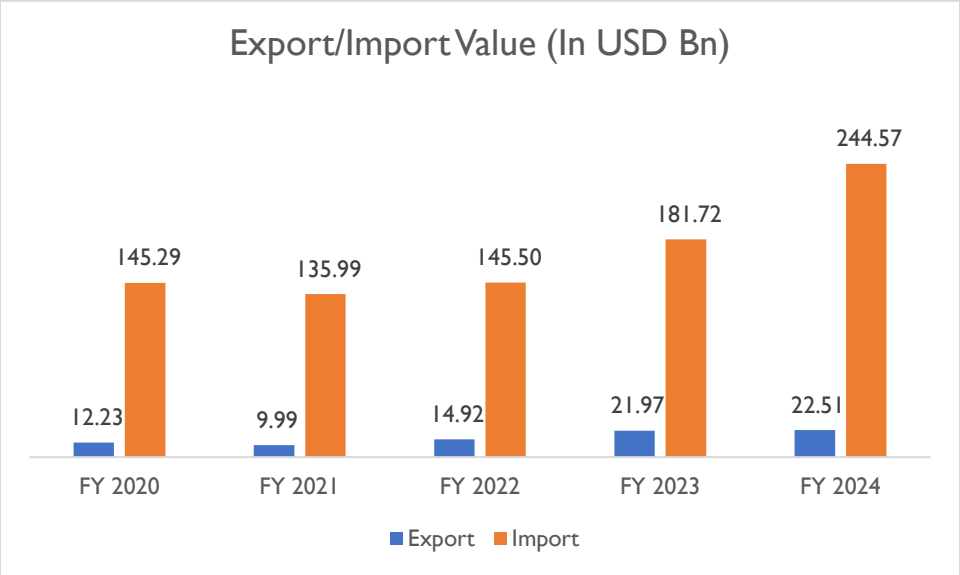
Domestic automobile demand is expected to accelerate further in FY 2025. This growth is fueled by various factors including rising income levels, urbanization, and a burgeoning middle class with increasing purchasing power. Moreover, Government push to attract investment in infrastructure sector, mining sector reform, and manufacturing industry will continue to drive Commercial vehicle growth. Thus, accelerating vehicle demand is likely to translate in strengthening demand for auto components.
Further, the launch of PLI, FAME and the "Make in India" initiative adopted by the Indian Government aims to facilitate investment, foster innovation, enhance skill development, and build a sustainable eco-system for the manufacturing infrastructure in the country. These measures would help in attracting interest and investment from the global & domestic investors.

Furthermore, rising investment in the automobile sector is likely to fuel the market growth. The automobile sector received a cumulative equity FDI inflow of about USD 36.268 Bn between April 2000 - March 2024. In addition to this India is on track to become the largest EV market by 2030, with a total investment opportunity of more than USD 200 Bn over the next 8-10 years.

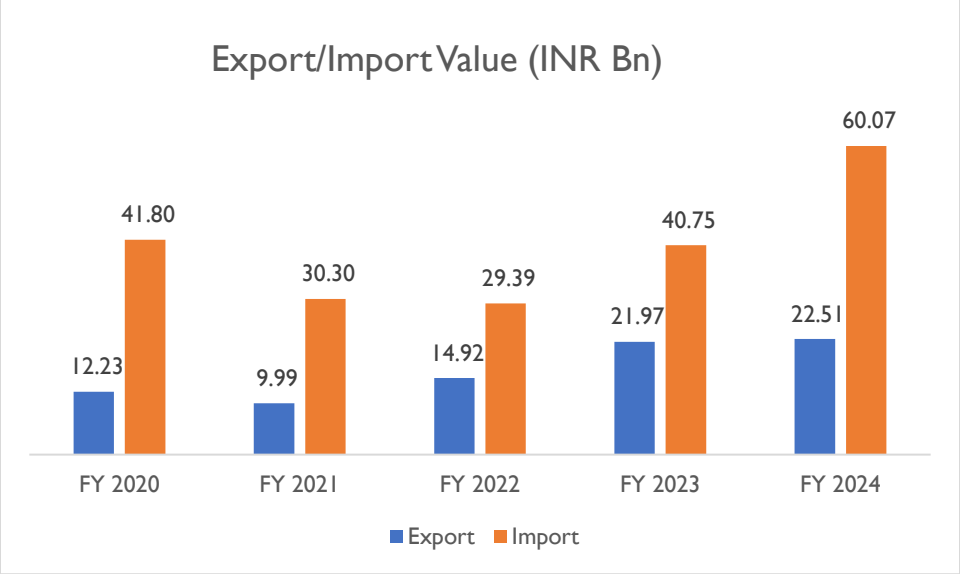
[8] https://pib.gov.in/PressReleasePage.aspx?PRID=2036674

Foreign Trade Scenario

During 2023-24, India exported Machines and Machinery appliances worth INR 22.51 billion, whereas import Machines and Machinery appliances has reached to INR 244.5 billion. In the period of FY2020-FY24, exports have experienced a (CAGR) of 16.5% and imports has accounted at nearly CAGR 14%.

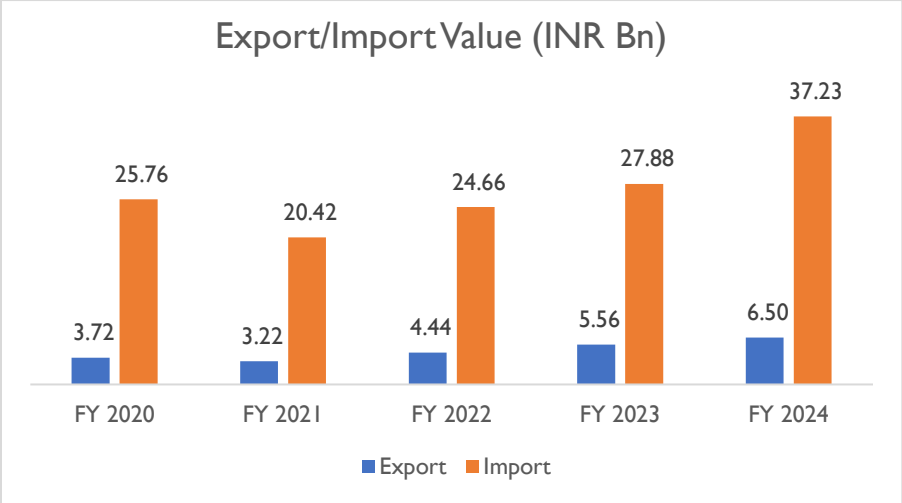


Source: Department of Commerce Trade Statistic
HS Code 8479 - Machines and mechanical appliances with individual functions, not specified.



Source: Department of Commerce Trade Statistic
HS Code 8428- Machinery and mechanical appliances for lifting, handling, loading, or unloading materials.

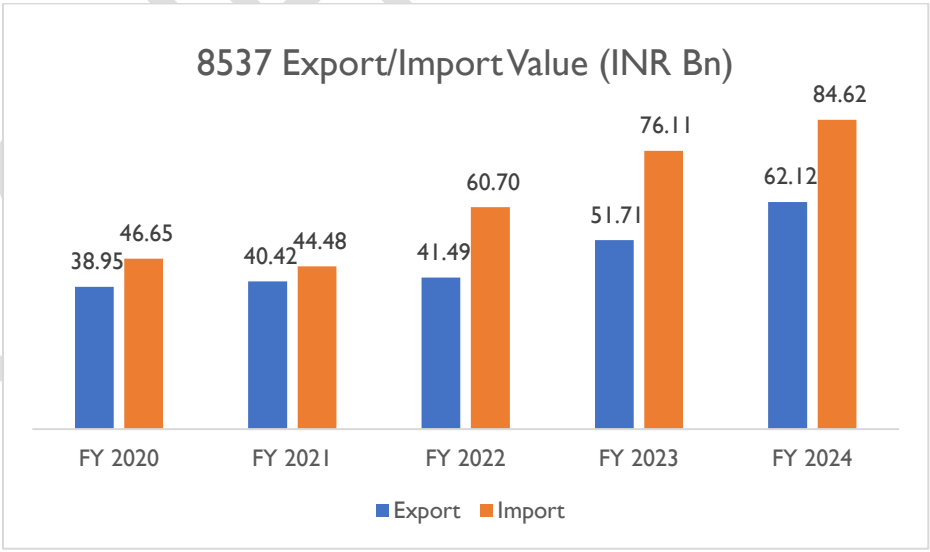
During 2023-24, India exported INR 22.51 billion worth of machinery and mechanical appliances. Meanwhile imports have reached to INR 60.07 billion. In the period of FY2020-FY24, exports have experienced a (CAGR) of 16.5%



Source: Department of Commerce Trade Statistic

HS Code 8515 - Electric machines and apparatus for soldering, brazing, welding, and similar processes,

During 2023-24, India exported electric machines and apparatus for soldering, brazing, welding, and similar processes, worth INR 6.5 billion. In the period of FY2020-FY24, exports have experienced a (CAGR) of 14.9%. India imported electric machines and apparatus for soldering, brazing, welding, and similar processes, worth INR 37.2 billion.



Source: Department of Commerce Trade Statistic

HS Code 8537 - Boards, panels, consoles, desks, cabinets, and other bases, equipped with two or more apparatus.

During 2023-24, India exported Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus, worth INR 62.12 billion. In the period of FY2020-FY24, exports have experienced a (CAGR) of 12.4%.

Top 3 export markets

HS Code	Countries Exported To
8479: Machines and mechanical appliances with individual functions, not specified.	USA (17%), Germany (6%), and Turkey (4%)
8428: Machines and mechanical appliances with individual functions, not specified.	USA (35%), Vietnam (5%), and UAE (4%)
8515: Electric machines and apparatus for soldering, brazing, welding, and similar processes,	USA (20%), Germany (16%), and UK (7%)
8537: Electric machines and apparatus for soldering, brazing, welding, and similar processes,	USA (22%), UAE (8%), and Nepal(4%)

Source: EXIM Data Bank

Top 3 import partners

HS Code	Countries Imported From
8479: Machines and mechanical appliances with individual functions, not specified.	Germany (15%), China (38%), and Japan (12%)
8428: Machines and mechanical appliances with individual functions, not specified.	China (44%), Germany (10%) and Japan (9%)
8515: Electric machines and apparatus for soldering, brazing, welding, and similar processes,	China (35%), Japan (24%), and Germany (12%)
8537: Electric machines and apparatus for soldering, brazing, welding, and similar processes,	Germany (21%), China (19%), and Japan (10%)

Regulatory Landscape

The Indian industrial automation solutions industry operates within a regulatory and policy framework designed to promote technological advancement, ensure safety, and foster economic growth. Key components of this framework include:

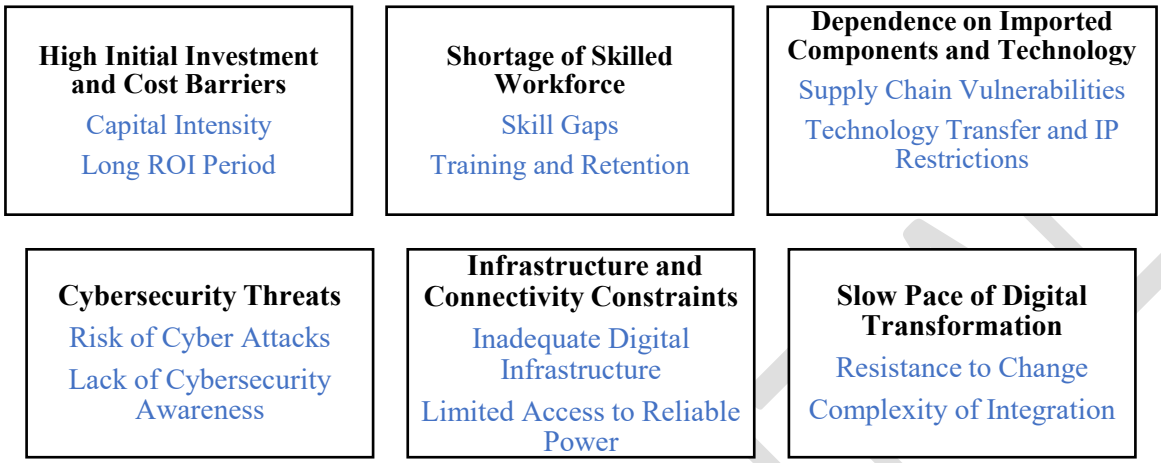
- **National Strategy on Robotics**: The Ministry of Electronics and Information Technology (MeitY) has drafted the 'National Strategy for Robotics' to position India as a global leader in robotics by 2030. This strategy focuses on strengthening innovation, providing a robust institutional framework, and engaging stakeholders to drive the adoption of robotic technology in India.
- **Standards and Guidelines:** The Bureau of Indian Standards (BIS) has established standards for industrial automation and robotics to ensure safety and interoperability. These standards cover various aspects, including safety requirements, performance criteria, and testing methodologies for industrial robots and automation systems.
- **Make in India Initiative**: Launched to transform India into a global manufacturing hub, this initiative focuses on enhancing skill development, fostering innovation, and building best-in-class manufacturing infrastructure. It aims to increase the manufacturing sector's contribution to GDP and create employment opportunities.
- **Digital India Programme:** This programme promotes the adoption of digital technologies across industries, including manufacturing. It encourages the integration of automation, artificial intelligence, and the Internet of Things (IoT) to enhance productivity and efficiency in industrial processes.
- **National Policy on Electronics (NPE) 2019**: This policy aims to position India as a global hub for Electronics System Design and Manufacturing (ESDM). It provides incentives for the promotion of manufacturing and export in the electronics sector, which is integral to industrial automation.
- **Modified Electronics Manufacturing Clusters (EMC 2.0) Scheme:** This scheme provides financial assistance for the setting up of both Electronics Manufacturing Clusters and Common Facility Centers. It aims to create world-class infrastructure along with common testing and training facilities to boost the electronics manufacturing ecosystem.
- **Atal Innovation Mission (AIM)**: AIM is a flagship initiative to promote a culture of innovation and entrepreneurship. It supports the establishment of Atal Tinkering Labs and Atal Incubation Centers, fostering innovation in automation technologies.

Policy initiatives / Government incentives designed to promote the industry activity.

- **Production Linked Incentive (PLI) Scheme:** Offers financial incentives to manufacturers based on their incremental sales from products manufactured in domestic units. It covers 14 key sectors, including electronics, pharmaceuticals, and automotive components, encouraging companies to set up and expand manufacturing capabilities within India.
- **Make in India Initiative**: Launched to transform India into a global manufacturing hub, this initiative focuses on enhancing skill development, fostering innovation, and building best-in-class manufacturing infrastructure. It aims to increase the manufacturing sector's contribution to GDP and create employment opportunities.
- **Digital India Programme:** This programme promotes the adoption of digital technologies across industries, including manufacturing. It encourages the integration of automation, artificial intelligence, and the Internet of Things (IoT) to enhance productivity and efficiency in industrial processes.

Threat & Challenges

Analysis of major threats & challenges impacting the industry



The industrial automation industry is currently facing several major threats and challenges, the major challenges are as follows,

High Initial Investment and Cost Barriers

The substantial initial investment required for automation technologies represents a significant barrier to entry for many businesses, particularly small and medium enterprises (SMEs). The financial implications associated with acquiring advanced machinery, and software, and the integration of these systems can be overwhelming. Many companies find it challenging to rationalize these upfront costs, especially considering that the return on investment (ROI) often takes several years to materialize—typically between 2 to 4 years, depending on the specific application and industry. This financial strain often results in a reluctance to adopt automation solutions, thereby limiting their potential advantages in terms of efficiency and productivity.

Shortage of Skilled Workforce

Another critical challenge is the shortage of skilled workforce capable of operating and maintaining advanced automation systems. As industries increasingly adopt the latest technologies, the demand for skilled labor in areas such as robotics, programming, and systems integration has surged. This skills deficit can slow down the implementation of automation initiatives and hinder overall productivity. Additionally, training existing employees or hiring new talent incurs further costs, compounding the initial investment challenge.

Dependence on Imported Components and Technology

The dependence on imported components and technology poses a risk to industrial automation firms. Many manufacturers rely on foreign suppliers for critical components such as sensors, controllers, and software platforms. This reliance can lead to vulnerabilities in supply chains, especially during geopolitical tensions or global disruptions like pandemics. Such dependencies can cause delays in production and increase costs due to tariffs or shipping issues, ultimately impacting operational efficiency.

Cybersecurity Threats

As industrial systems become more interconnected through the Internet of Things (IoT) and Industry 4.0 initiatives, they also become more exposed to cybersecurity threats. Cyberattacks targeting industrial control systems (ICS) have increased significantly, with many organizations reporting incidents that lead to operational disruptions. The complexity of modern automation systems often means that security measures are insufficient or improperly implemented, making them attractive targets for cybercriminals. Protecting these systems requires ongoing investment in cybersecurity solutions and training, adding another layer of cost and complexity.

Infrastructure and Connectivity Constraints

Infrastructure and connectivity constraints also present challenges for industrial automation. Many facilities may lack the necessary digital infrastructure to support advanced automation technologies effectively. Issues such as inadequate broadband connectivity or outdated legacy systems can limit the ability to implement IoT solutions or integrate new technologies seamlessly. This lack of infrastructure can stifle innovation and prevent companies from fully realizing the benefits of automation.

Competitive Landscape

There are few large multinational and domestic companies which provide end-to-end solutions. These companies have expertise in both hardware and software integration while smaller firms are primarily equipment suppliers. Some of the leading companies offering factory automation solution in India are General Electric, Rockwell Automation, Siemens India Ltd., BHEL, Honeywell Automation India Ltd., ABB India, KUKA Robotics India, Mitsubishi Electric Corporation, Larsen & Toubro Ltd, Yokogawa Electric Corporation Titan Engineering and Automation Ltd, Fuji Electric Co. Ltd, B&R Industrial Automation Private Ltd, Schneider Electric, and Precision Automation & Robotics India, amongst others.

Analysis of key factors shaping competition in the sector

The Indian industrial automation sector is highly competitive and dynamic, driven by several key factors that influence market positioning, innovation, and growth. Key factors shaping competition are:

- Technological Advancements: The rapid adoption of Industry 4.0 technologies such as the Industrial Internet of Things (IIoT), artificial intelligence, and machine learning is driving competition. Companies that can integrate these advancements are more likely to stay ahead in providing smart, connected solutions.
- Robotic Process Automation (RPA): Automation in manufacturing and service sectors is increasingly driven by robotics and machine automation. Companies that offer advanced RPA solutions are well-positioned to meet the growing demand for efficiency and precision.
- Cost Competitiveness and Operational Efficiency: Indian companies focus on reducing production costs by automating repetitive tasks and minimizing human error. This is crucial in a price-sensitive market, where cost efficiency can be a major competitive advantage.
- Global vs. Local Players: International companies often bring advanced technologies and greater R&D investments, while domestic companies are more agile and understand local market needs better. Collaboration between global and Indian firms for technical innovation and market access impacts the competition dynamics. Thus, partnerships with OEMs, Tier I suppliers, and technology providers (robotics manufacturers, AI developers, etc.) are increasingly common in this automobile industry.
- Cloud and Edge Computing: As automation systems generate vast amounts of data, cloud and edge computing solutions are becoming essential for data storage, analysis, and process optimization. Companies that provide secure, scalable data solutions gain a competitive advantage.

Profiling of Major Companies

Precision Automation & Robotics India Private Limited (PARI)

Precision Automation & Robotics India Private Limited (PARI) was founded in 1990 and is headquartered in Pune, India. The company has more than 1,300 employees and multiple global facilities. PARI specializes in welding solutions and technologies specifically designed to meet the diverse requirements of the manufacturing sector. In 2021, PARI was integrated into Wipro Enterprises, which significantly enhanced its capabilities in industrial automation and robotics, now operating under the name Wipro PARI.

Key Offerings

PARI delivers a comprehensive array of automated welding solutions that are engineered to enhance productivity and precision, which include,

- Part Design Optimization
- Process & Line Design
- Input Part Validation
- Innovative Fixture Design
- Optimized Indexing Technology

PARI utilizes various welding techniques tailored to meet the specific needs of different industries:

- **MIG (Metal Inert Gas) Welding:** This core offering provides high-quality, cost-effective welding solutions suitable for a variety of metals and alloys. It is particularly advantageous for automotive applications due to its fast-welding speeds and robust joint formation.
- **Spot Welding**: Widely utilized in automotive assembly lines, this method facilitates efficient joining of sheet metal. PARI's automated spot-welding solutions are designed to minimize overheating and reduce weld times.
- **TIG (Tungsten Inert Gas) Welding**: Renowned for its precision, TIG welding is ideal for working with thin materials, especially non-ferrous metals. PARI applies this technique across a spectrum of applications, from small-scale industries to aerospace manufacturing.

Jendamark India Pvt. Ltd:

Incorporated on 06 January 2010, Jendamark India Pvt. Ltd. is a subsidiary of Jendamark Automation, with its global head office in South Africa and additional offices in Germany and the USA. The company is headquartered in Pune, India. This global presence enables Jendamark to serve automotive customers worldwide, offering round-the-clock service support.

Key Offerings:

- Powertrain Assembly Systems: Jendamark specializes in the assembly of automotive powertrain systems, providing solutions ranging from completely manual to fully automated systems.
- Electric Vehicle (EV) Assembly: The company designs and manufactures battery pack and power electronics assembly systems for the electric vehicle market, supporting the global shift towards cleaner energy.
- Catalytic Converter Assembly Systems: Jendamark offers adaptive canning facilities that accommodate complex assembly requirements to meet varying emissions norms.
- Industry 4.0 Solutions: Through its Odin Manufacturing division, Jendamark provides a range of integrated digital technologies designed to improve production efficiencies for the global manufacturing sector.

Affordable Robotic & Automation Ltd. (ARAPL):

Established in 2005 and headquartered in Pune, India, ARAPL has been a leader in the automation industry for over a decade, serving sectors such as automotive, non-automotive, general industries, and government. The company has expanded its customer base across India, China, and other parts of Asia.

Key Offerings:

- Industrial Automation: ARAPL provides turnkey solutions for various industrial automation needs, including line automation, assembly lines, conveyors, robotic inspection stations, pick & place systems, gantries, auto assembly stations, robotic welding cells and lines, fixed, indexing & rotary type welding fixtures, and special-purpose machines (SPMs) for welding.
- Car Parking Solutions: The company designs effective and efficient car parking systems tailored to client requirements, optimizing space utilization, and enhancing parking efficiency.
- Warehouse Automation: ARAPL offers services aimed at streamlining operations, improving efficiency and production, and reducing costs within warehouse environments.

DiFACTO Robotics and Automation Pvt. Ltd.:

Established in 2007 and headquartered in Bangalore, India, DiFACTO Robotics and Automation Pvt. Ltd. is a provider of robotic automation solutions in the Indian manufacturing sector.

Key Offerings:

- Robotic Systems: DiFACTO specializes in designing and implementing robotic systems tailored to various industrial applications, enhancing efficiency and precision in manufacturing processes.
- Customized Solutions: The company provides bespoke automation solutions to meet specific client requirements, ensuring seamless integration with existing operations.
- Standard Products: DiFACTO offers a range of standard automation products that cater to common industrial needs, facilitating quick deployment and scalability.
- Automation Services: Beyond product offerings, DiFACTO delivers comprehensive automation services, including consultation, implementation, and support, to optimize manufacturing workflows.

Faith Automation Systems & Tooling Pvt. Ltd.:

Established in 2014 and headquartered in Pune, Maharashtra, India, Faith Automation Systems & Tooling Pvt. Ltd. specializes in providing advanced automation solutions and tooling services across various industries, with a strong focus on the automotive sector.

Key Offerings:

- Robotic Integration: Faith Automation offers services in integrating robotic systems into existing manufacturing processes, enabling automation of tasks such as welding, material handling, and assembly. This integration enhances productivity and ensures consistent quality.
- Special-Purpose Machinery (SPM): The company designs and manufactures SPMs tailored to specific production requirements, addressing unique challenges in the manufacturing process and optimizing operational efficiency.
- Welding Fixtures: Faith Automation provides innovative welding fixtures that ensure precise alignment and secure holding of components during welding operations, resulting in improved weld quality and reduced cycle times.
- Automated Testing and Inspection Systems: The company develops automated systems for testing and inspecting components, ensuring that products meet stringent quality standards and reducing the likelihood of defects.

Financial Benchmarking [9]

Company Name	Patil Automation Limited	Wipro Pari	Affordable Robotic & Automation
Parameter (INR Million)	**FY 2024**	**FY 2024**	**FY 2024**
Total Income	1,187.15	18,947.14	1,501.81
Revenue from Operations	1,152.79	18483.77	1,500.74
EBITDA	158.79	2,563.67	128.44
EBITDA Margin	13%	13.53%	8.55%
PAT	75.75	1360.92	60.71
PAT Margin	6%	7.18%	4.04%
Operating Cash Flow	111.14	-1894.60	-20.12
Net Worth	316.97	6179.81	1055.35
Long Term Borrowing	4.54	-	156.31
Debt Equity Ratio	0.02	2.40	0.46
Return on Capital Employed	0.33	0.39	0.06
Return on Equity	0.35	0.53	0.06

In FY 2024, Wipro PARI's total income was 18,947.14 million, and revenue from operations to INR was 18,483.77 million, substantially surpassing its competitors. The company also demonstrates strong profitability, reporting an EBITDA of INR 2,563.67 million and a PAT of 1,360.92 million, resulting in a PAT margin of 7.18%. In contrast, Patil Automation Limited generated a total income of INR 1,187.15 million and revenue from operations of INR 1,152.79 million, with an EBITDA of INR 158.79 million and a PAT of INR 75.75 million, yielding a PAT margin of 6%. Affordable Robotic & Automation reported total income and revenue from operations of INR 1,501.81 million and INR 1,500.74 million, respectively, but lagged in profitability with an EBITDA of INR 128.44 million and a PAT of INR 60.71 million, resulting in a PAT margin of 4.04%.

Wipro PARI demonstrates strengths in revenue generation and profitability metrics, although it faces challenges with a negative operating cash flow of INR 1,894.60 million. In contrast, Patil Automation Limited maintains a positive operating cash flow of INR 111.14 million. It showcases a low debt-equity ratio of 0.02, reflecting strong financial stability and minimal reliance on debt financing. Meanwhile, Affordable Robotic & Automation presents a moderate debt-equity ratio of 0.46 and has long-term

[9] Company's Audited Financial and Annual Report

borrowing amounting to INR 156.31 million. However, needs to address its negative operating cash flow of INR 20.12 million to improve its financial health.

In terms of return on capital employed and return on equity, Wipro PARI took a lead over the other two player as it measured 0.39 and 0.53, respectively, indicating effective management in generating profits. While Patil Automation Limited ROCE and ROE was relatively close to Wipro Pari and it measured 0.33 and 0.35, respectively. However, Affordable Robotic & Automation's ROCE and ROE both measured at 0.06, substantially lower in comparison to the two other players.

Company Profile

Patil Automation Limited

Patil Automation Limited, founded in 2015 in Pune, India, is a leading automation solutions provider dedicated to delivering innovative and high-quality products. With 200+ qualified employees, the company boasts specialized teams in development, engineering, and customer service. Its state-of-the-art production facilities and commitment to quality assurance ensure reliable automation solutions tailored to client needs, supported by a robust power backup system for uninterrupted operations.

Key Offerings

Patil Automation Limited offers a diverse range of automation solutions which include,

- **Line Automation**: Complete assembly line automation with features such as pick & place systems, gantry provisions, and inspection stations equipped with Poka Yoke technology.
- **Robotic Welding & Handling**: Solutions for both horizontal and vertical welding, including special purpose machines (SPMs) for circular welding and manual welding fixtures for MIG, TIG, and spot welding.
- **Special Purpose Machines**: Equipment designed for specific tasks such as leakage testing, plasma gluing, and various inspection stations.
- **Material Handling Systems**: Custom-designed systems for handling materials across different applications, ranging from delicate to heavy-duty tasks.

Power Backup

To maintain uninterrupted operations, Patil Automation Limited guarantees 100% power backup, reflecting its commitment to reliability and operational excellence.

Financial Indicator[10]

Patil Automation Limited	FY 2022	FY 2023	FY 2024
(INR Million)			
Total Income	970.93	824.23	1187.15
Revenue from Operations	941.62	778.07	1152.79
EBITDA	108.74	95.56	158.79
EBITDA Margin	11%	12%	13%
PAT	53.89	41.22	75.75
PAT Margin	6%	5%	6%
Operating Cash Flow	71.20	53.93	111.14
Net Worth	669.69	241.23	316.97
Long Term Borrowing	-	0.81	4.54
Debt Equity Ratio	0.02	0.03	0.02
Return on Capital Employed	0.32	0.20	0.33
Return on Equity	0.36	0.22	0.35

Patil Automation Limited has experienced significant fluctuations in its financial performance from FY 2022 to FY 2024. Total income fell by approximately 15% in FY 2023, from INR 970.93 million to INR 824.23 million, but rebounded by ~44% to INR 1,187.15 million in FY 2024. Similarly, revenue from operations decreased from INR 941.62 million in FY 2022 to INR 778.07 million in FY 2023 before recovering to INR 1,152.79 million in FY 2024, indicating a demand for automation solutions.

The company's EBITDA also showed a downward trend in FY 2023, decreasing from INR 108.74 million in FY 2022 to INR 95.56 million, a decline of approximately 12.0%. However, it recovered in FY 2024 with EBITDA rising to INR 158.79 million, an increase of 66.1% compared to the previous year.

Patil Automation Limited's Profit After Tax (PAT) declined from INR 53.89 million in FY 2022 to INR 41.22 million in FY 2023, reflecting challenges in maintaining profitability amid fluctuating revenues. However, PAT increased significantly to INR 75.75 million in FY 2024, indicating effective management strategies. The PAT margin remained stable at 6% in FY 2022, dipped to 5% in FY 2023, and returned to 6% in FY 2024.

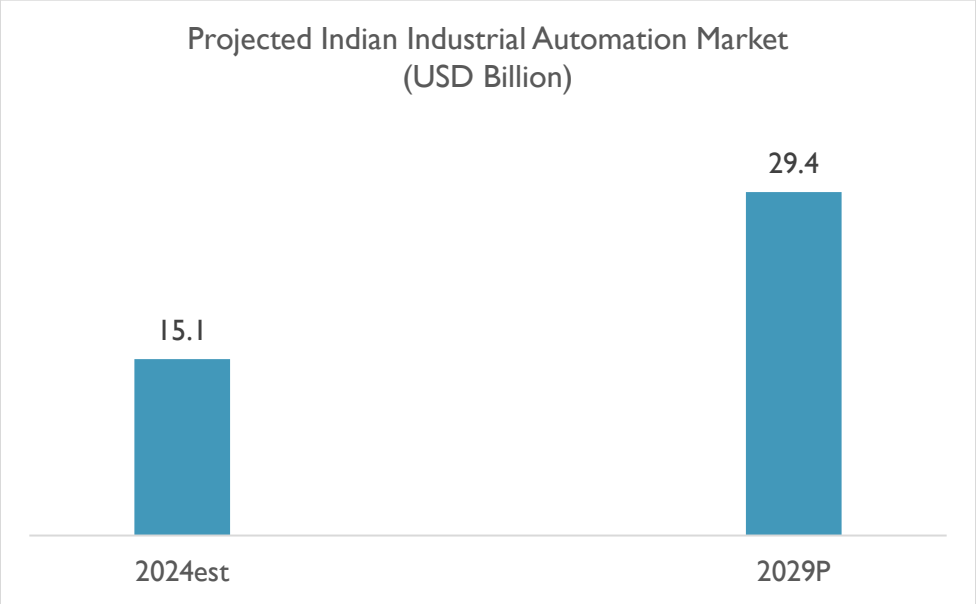
[10] Company's Audited Financials

Operating cash flow saw a significant decline from INR 71.20 million in FY 2022 to INR 53.93 million in FY 2023 and in FY 2024 increased and reached INR 111.14 million

The company reported no long-term borrowing in FY 2022 but took on a small debt in subsequent years, rising to INR 0.81 million in FY 2023 and increasing to INR 4.54 million in FY 2024. However, its debt-to-equity ratio remained relatively low throughout the period, standing at 0.02 in both FYs 2022 and 2024, while slightly increasing to 0.03 in FY 2023.The key ratios reveal a stable debt-to-equity ratio of around 0.02 to 0.03 across the three years, suggesting low leverage and a conservative approach towards debt financing.

Growth Forecast

The Indian Industrial automation solutions industry is expected to grow from USD 15.12 billion in 2024 to USD 29.43 billion by 2029, growing at a CAGR of 14.2% during the forecast period.[11]



The future growth of the Indian industrial automation solutions industry is influenced by several key factors:

- Technological Advancements and Industry 4.0 Adoption: The adoption of Industrial Internet of Things (IIoT), artificial intelligence, and machine learning is crucial for enhancing automation capabilities. As more companies embrace smart manufacturing, the demand for connected automation solutions will grow. SAMARTH Udyog Bharat 4.0 is an Industry 4.0 initiative of Ministry of Heavy Industry & Public Enterprises, Government of India under its scheme on Enhancement of Competitiveness in Indian Capital Goods Sector.
- Automation for Tier 2 Suppliers: Beside Tier 1 suppliers who are the primary customers for automation providers, there is an increasing demand for automation from Tier 2 suppliers who are likely to adopt automation solutions to remain competitive and meet the customers' demand.
- India emerging as a manufacturing hub: As India emerging as automotive manufacturing hubs for global players, the need for high-quality automation systems is expected to rise. The country present promising growth opportunity for automation to expand as labor costs rise in India are rising too.

[11] Syndicated Research

- Cost Competitiveness and Return on Investment (ROI): While automation can be capital-intensive, cost-effective solutions are crucial in India's price-sensitive market. Solutions that provide high ROI by reducing labor costs, minimizing downtime, and enhancing productivity will likely gain traction.
- Workforce Skill Development and Labor Dynamics: Access to a well-trained workforce is crucial for industries that rely on technical expertise. Skill gaps in areas like data science, engineering, or IT can limit growth if industries can't find the talent to support their operations.
- Supply Chain Resilience and Local Manufacturing: Industries relying on a global supply chain benefit from resilience and risk mitigation strategies, such as diversifying suppliers and increasing domestic production to avoid disruptions.
- Investment in R&D and Innovation: The industry is competitive, with rapid innovation driving new products and solutions. Companies that invest in research and development to create advanced and differentiated solutions will be able to capture larger market shares.
- Competitive Landscape: High competition drives companies to innovate and improve efficiency to stay competitive. Market saturation or the presence of dominant players can affect profitability, while new entrants can increase competition.