# Global Metal Injection Molding Report

IPO Research: Global Metal Injection Molding Market Assessment

July 2026

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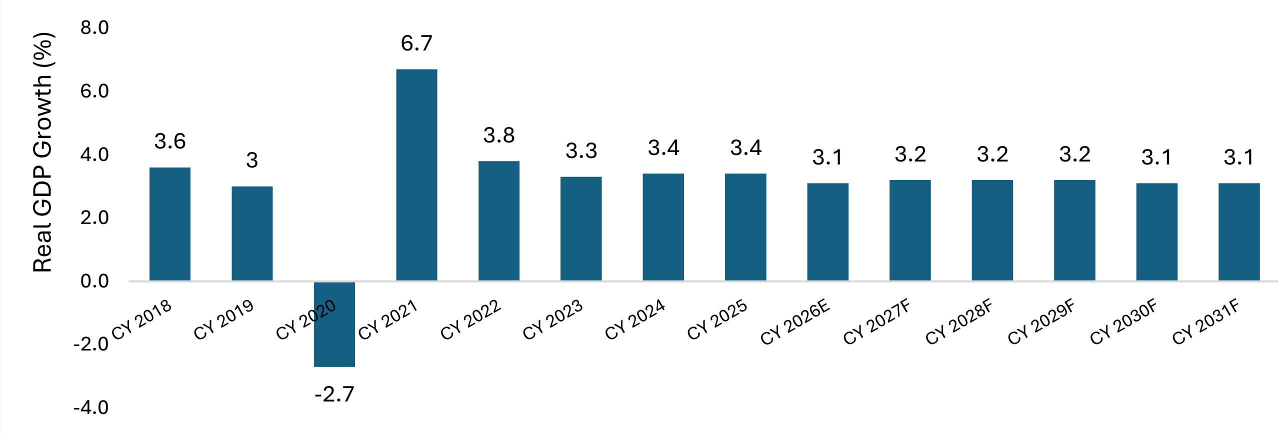
## 1.1 Global Economic Trends and Outlook for CY 2026

### 1.1.1 Global Economic Growth Will Moderate to 3.1% in CY 2026

**Exhibit 1: GDP Growth, Global, CY 2018-2031F**




*Note: E: Estimate, F: Forecast Source: International Monetary Fund (IMF); Frost & Sullivan*

Global GDP growth is expected at 3.1% in CY 2026 and 3.2% in CY 2027. The US-Israel-Iran conflict is expected to keep oil prices elevated to an average of $110-120/ barrel through Q2 CY 2026. This will push near-term global inflation higher, compressing real incomes and industrial margins especially in countries that are net importers of crude oil and derived commodities. The US is expected to remain relatively resilient in CY 2026, supported by fiscal measures, prior interest rate cuts, and LNG export gains linked to disruptions in Qatar's LNG infrastructure and supply, although higher energy prices may weigh on consumption. Global growth will improve to 3.2% in CY 2027 as geopolitical conditions stabilize[1], and will average 3.2% annually from CY 2027 to CY 2031.

In CY 2026, advanced economies[2] are expected to grow 1.8%, while the emerging and developing economies grow by 3.9%. Emerging markets will continue to outpace advanced economies in growth through long-term benefits from favorable demographics and expanding industrial capacity. Countries like India and Vietnam and Middle Eastern nations such as Saudi Arabia and United Arab Emirates (UAE) are expected to be growth frontrunners.[3]

### 1.1.2 Global Economic Predictions for CY 2026 and CY 2027

- **Global Growth to Ease Amid Oil-Driven Inflation, with Uneven Regional Recovery:** Global growth is projected to slow from 3.4% in CY 2025 to 3.1% in CY 2026 as elevated oil prices of $110–120 per barrel in Q2 CY 2026 during the US-Iran conflict sustain inflationary pressures and weaken real incomes and margins. Growth is expected to remain stronger in the US, resilient in Saudi Arabia and the UAE, and weaker in Qatar, Europe, Japan, and Southeast Asia. Saudi Arabia and the UAE are supported by trade rerouting and diversification, while disruptions to Qatar's LNG infrastructure increased LNG exports from the US to Asia between February and March 2026.
- **Supply and Energy Disruptions Expected to Keep Inflation Elevated and Delay Monetary Easing:** Supply chain, shipping, and energy disruptions through Q2 CY 2026 are expected to keep global inflation elevated at 4.4% in CY 2026 versus 4.1% in CY 2025, delaying further monetary easing across key economies until late 2026. In a pessimistic case, a prolonged energy supply shock, could warrant interest rate spikes, especially in energy imports dependent nations.
- **Trade Momentum to Moderate Amid Geopolitical Disruptions and Rising Costs:** Global merchandise trade growth is expected to moderate from 4.6% in CY 2025 to 1.9% in CY 2026 due to Middle East disruptions and higher freight and insurance costs linked to the Strait of Hormuz closure. Alternative trade routes may

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1 The analysis is based on the assumption that US-Iran peace deal will be reached by end of Q2 or in early Q3 2026. This will ensure geopolitical and economic stability being restored in H2 2026.

2 Countries with a high level of industrialization and income per capita, diversified export products, along with developed financial markets are characterized as advanced economies. List of Advanced economies and Emerging and Developing economies can be accessed here.

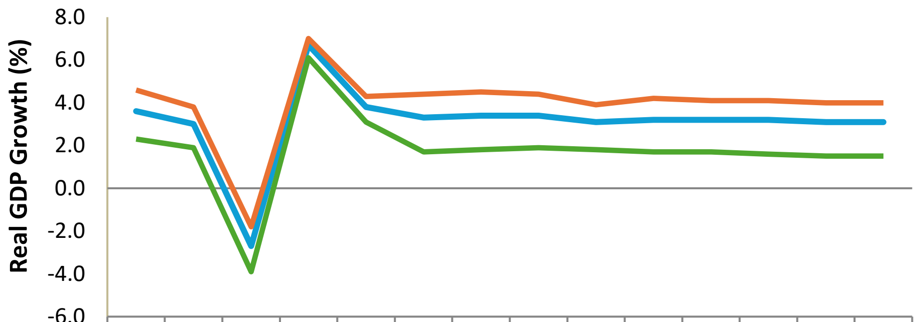
3 IMF; Frost & Sullivan

partly offset the impact, while a gradual recovery is expected from Q4 CY 2026 following a potential US-Iran ceasefire in late Q2 or Q3 CY 2026. Geopolitical tensions, volatile trade policies, business investment uncertainty, and supply chain disruptions continue to increase trade uncertainty and costs.

- **Labor Markets to Stay Tight Despite Slowing Growth:** Labor markets are expected to remain tight despite slower growth, with wage and employment gaps between high skilled and low skilled workers widening further. Continued investment in AI infrastructure and advanced technologies is expected to support demand and wage growth for specialized talent, while lower skilled and routine roles may face rising automation related displacement pressures.

## 1.2 Global Growth and Inflation Outlook for CY 2031

**Exhibit 2a: GDP Growth, Global, CY 2018–2031F**



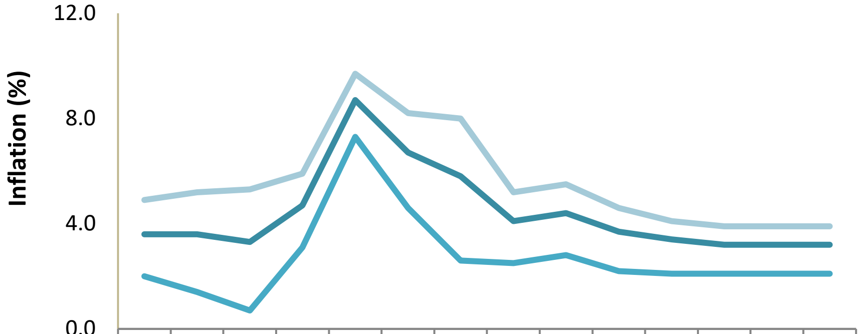

| | CY 2018 | CY 2019 | CY 2020 | CY 2021 | CY 2022 | CY 2023 | CY 2024 | CY 2025 | CY 2026E | CY 2027F | CY 2028F | CY 2029F | CY 2030F | CY 2031F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| World | 3.6 | 3.0 | -2.7 | 6.7 | 3.8 | 3.3 | 3.4 | 3.4 | 3.1 | 3.2 | 3.2 | 3.2 | 3.1 | 3.1 |
| Advanced Economies | 2.3 | 1.9 | -3.9 | 6.1 | 3.1 | 1.7 | 1.8 | 1.9 | 1.8 | 1.7 | 1.7 | 1.6 | 1.5 | 1.5 |
| Emerging and Developing Economies | 4.6 | 3.8 | -1.8 | 7.0 | 4.3 | 4.4 | 4.5 | 4.4 | 3.9 | 4.2 | 4.1 | 4.1 | 4.0 | 4.0 |

*Note: E: Estimates, F: Forecasts. List of Advanced economies and Emerging and Developing economies can be accessed here. Source: IMF; Frost & Sullivan*

Investment and policy uncertainty stemming from geopolitical tensions from US-Iran war will weigh on CY 2026 global growth, which is forecast to ease from 3.4% in CY 2025 to 3.1% in CY 2026. While the risk of an escalation in the Middle East conflict is a near-term headwind, growth upsides could emerge from a US-Iran peace deal in late Q2 or early Q3 CY 2026.

Between CY 2026 and CY 2031, the global economy is expected to grow at an average of 3.2%, with emerging and developing economies being the main drivers. Within the emerging markets, factors such as robust consumer demand, cost competitive manufacturing capabilities coupled with lower interest rate levels will provide impetus. However, the advanced nations will see a modest acceleration over the forecast period, with an annual average real GDP growth of 1.6% in the CY 2026 to CY 2031 period.

**Exhibit 2b: Inflation, Global, CY 2018–2031F**




| | CY 2018 | CY 2019 | CY 2020 | CY 2021 | CY 2022 | CY 2023 | CY 2024 | CY 2025 | CY 2026E | CY 2027F | CY 2028F | CY 2029F | CY 2030F | CY 2031F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| World | 3.6 | 3.6 | 3.3 | 4.7 | 8.7 | 6.7 | 5.8 | 4.1 | 4.4 | 3.7 | 3.4 | 3.2 | 3.2 | 3.2 |
| Advanced Economies | 2.0 | 1.4 | 0.7 | 3.1 | 7.3 | 4.6 | 2.6 | 2.5 | 2.8 | 2.2 | 2.1 | 2.1 | 2.1 | 2.1 |
| Emerging and Developing Economies | 4.9 | 5.2 | 5.3 | 5.9 | 9.7 | 8.2 | 8.0 | 5.2 | 5.5 | 4.6 | 4.1 | 3.9 | 3.9 | 3.9 |

*Note: E: Estimates, F: Forecasts. List of Advanced economies and Emerging and Developing economies can be accessed here. Source: IMF; Frost & Sullivan*

Global average inflation stood at 4.1% in CY 2025 and is expected to remain slightly elevated at 4.4% through CY 2026. Disruptions to shipping routes, supply chains, and energy infrastructure arising from Middle East tensions are expected to increase global headline inflation to 4.4% in CY 2026. Inflationary pressures are projected to rise across both advanced and emerging economies, with emerging markets and developing economies remaining more vulnerable due to greater dependence on imported energy and commodity price fluctuations. From CY 2027 onwards, inflation is expected to ease across advanced and emerging economies as Middle East tensions stabilize[4] and oil prices moderate. Lower inflation, improving real incomes, and more stable financing conditions are expected to support a gradual recovery in consumption and investment.

## 1.3 Growth Outlook for Major Economies

### 1.3.1 Growth Outlook for Major Economies

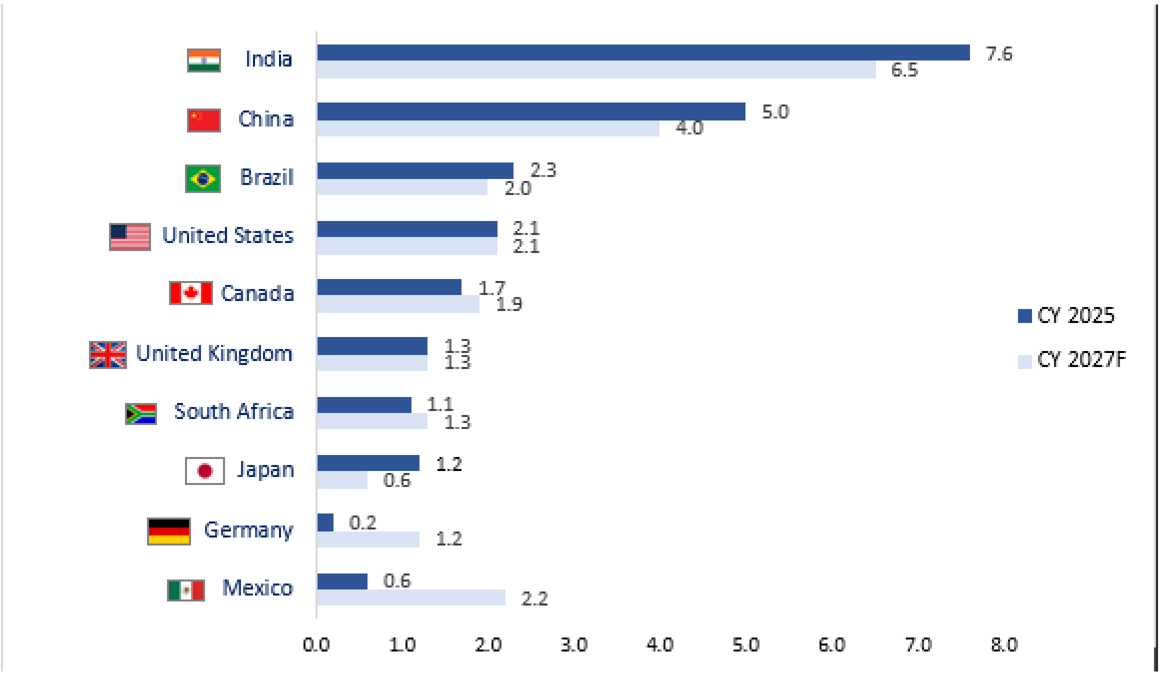
The chart below compares CY 2025 GDP growth against CY 2027 growth forecasts for select economies. Forecasts indicate that in FY 2027-2028, India will see the highest growth at 6.5%.

In the US, real GDP growth was 2.1% in CY 2025, supported by strong AI and technology investment, large government spending, and Federal Reserve interest rate cuts that boosted consumption and investment. Growth is projected to remain at 2.1% in CY 2027 as the impact of earlier interest rate cuts fades and technology investment slows from recent highs, offset by tax incentives under the One Big Beautiful Bill Act (OBBBA) that continue to support business investment.

Germany's real GDP growth was constrained at 0.2% in CY 2025 by weak industrial activity, subdued exports and high energy costs. However, the government's EUR 500 billion (~12% of GDP) infrastructure fund approved in March 2025, alongside reforms to the debt brake to enable higher infrastructure and defence spending, is expected to support investment in transport, digital infrastructure, energy, healthcare, education and R&D. These measures will help accelerate growth to 1.2% in CY 2027, although energy supply disruptions will remain a headwind for Germany and other major European economies, including the UK.

[4] The analysis is based on the assumption that US-Iran peace deal will be reached by end of Q2 or in early Q3 2026. This will ensure geopolitical and economic stability being restored in H2 2026.

**Exhibit 3: GDP Growth, Select Economies, CY 2025 and 2027F**




*Note: India's data is presented for fiscal years; for example, 2025 refers to data for FY 2026 (April 2025–March 2026) and 2027 data refers to FY2028 (April 2027–March 2028). Sources: IMF; Frost & Sullivan*

China remained on a slowing growth trajectory in CY2025, with real GDP growth of 5.0%, as weak domestic demand, the prolonged property sector downturn and subdued consumer confidence weighed on economic activity despite government measures to boost consumption, support the property market and increase infrastructure investment. Growth is projected to moderate to 4.0% in CY2027 as structural challenges, including an ageing population and a softer labour market, continue to constrain economic activity.

Despite softer global growth conditions, the Indian economy has remained resilient and is expected to continue outperforming most major economies. Real GDP grew by 7.6% in FY2026, supported by strong domestic demand, sustained government expenditure on infrastructure and manufacturing, and improved export competitiveness following the reduction in US tariffs on Indian exports from 50% to 10%[5]. Growth is projected to remain robust at 6.5% through FY2028, supported by continued investment and resilient domestic demand.

### 1.3.2 India Growth Outlook Until FY 2032

India has emerged as a global economic bright spot. From domestic demand-driven resilience in the recent years there is a shift underway to government capital expenditure-driven growth momentum. Robust domestic demand will continue to remain a medium to long-term growth driver for India, supported by the country's demographic dividend and growing middle class.

India witnessed robust growth of 7.6% in FY 2026 supported by strong domestic demand, low inflation, and the GST reforms and income tax reforms boosting consumption Real GDP growth is expected to moderate to 6.5% in FY 2027 as the temporary consumption boost from GST reforms fades. Growth will also moderate due to the impact of inflation pressures from elevated global energy prices, linked to Middle East oil supply disruptions arising from the US-Iran conflict. In FY 2027, growth will continue being driven by strong domestic demand and government CAPEX, and increased US exports from the reduction in US tariffs on Indian goods from 50% to 10%.[6] In contrast to recessionary conditions in some advanced economies and China's uneven economic recovery,

[5] Further trade upsides could emerge if the 7th May 2026 ruling by the US Court of International Trade, which challenged the legal basis of the 10% tariffs, is upheld.

[6] Further trade upsides could emerge if the 7th May 2026 ruling by the US Court of International Trade, which challenged the legal basis of the 10% tariffs, is upheld.

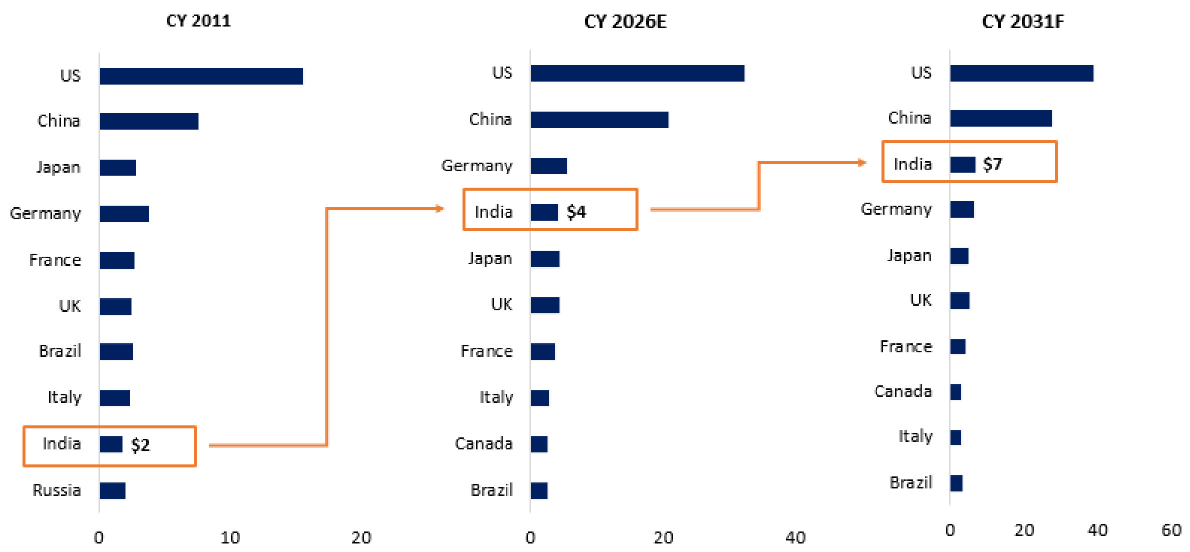
India has emerged a global growth frontrunner. India's strong growth expectations are in part encouraging redirection of investments to India, especially as China+1 strategies gain momentum.

India's interest rate cycle was accommodative through FY26, with the RBI cutting the repo rate from 6.50% levels in early CY2025 to 5.25% in December 2025 amid easing inflation and growth support measures. Since then, the RBI has held rates steady at 5.25% through mid-2026 under a neutral stance. This stance has remained despite the disruption resulting from the US-Iran war.

With respect to inflation, India's annual inflation is forecast to average at 4.1% between FY 2027 and FY 2032. Following the inflation surge in FY 2027 due to higher energy costs from the energy supply disruptions from the US-Iran war. Although India retains access to the Strait, higher global energy prices are expected to increase fuel and power costs, leading to higher transportation and manufacturing expenses and exerting upward pressure on prices across goods and services. Over the medium term, inflation is projected to moderate toward around 4.0% through FY 2032, indicating a relatively stable pricing environment within the Reserve Bank of India's target inflation range of 2–6%. This outlook is supported by improving domestic supply chain management, prudent fiscal measures, and targeted interventions to stabilize food prices, which remain sensitive to weather related disruptions.

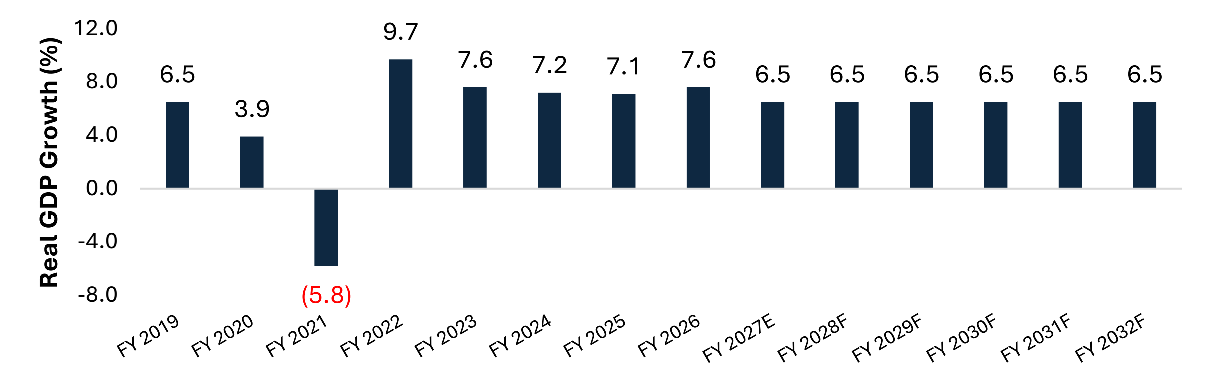
Despite multiple geopolitical disruptions in recent years, India's growth outlook remains strong with around 6.5% real GDP growth expected between FY 2027 and FY 2032. It is poised to overtake Germany to become the 3rd largest economy globally by CY 2031 to become a ~ USD 7 trillion economy in nominal GDP terms.

**Exhibit 4: Top 10 Economies by Nominal GDP (in USD trillion), Global, CY 2011, CY 2026E, CY 2031F**



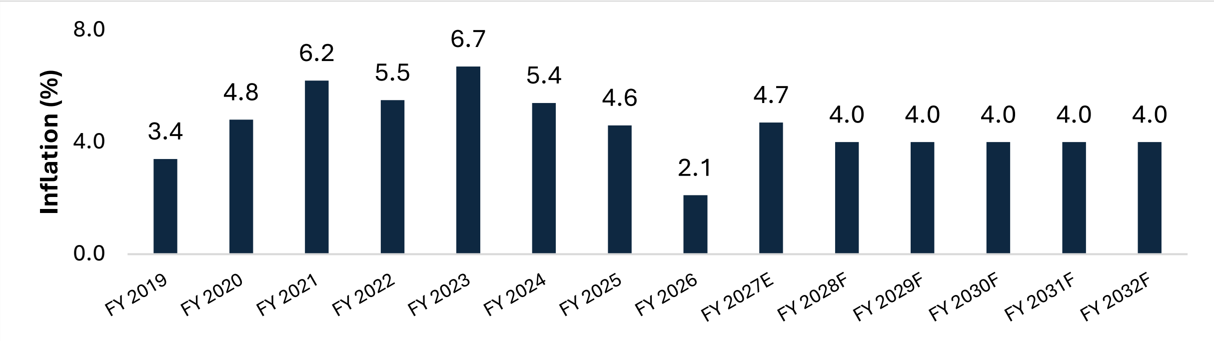

*Note: E: Estimates; F: Forecasts. India's data is represented in fiscal years i.e. CY 2026 refers to the period between April 2026 and March 2027. Sources: IMF; Frost & Sullivan*

**Exhibit 5: Real GDP Growth, India, FY 2019-FY 2032F**




*Note: E: Estimates; F: Forecasts. India's data is represented in fiscal years i.e., FY 2025-26 is the 12-month period between 1 April 2025 and 31 March 2026. Sources: Ministry of Statistics and Programme Implementation (MoSPI); IMF; Frost & Sullivan*

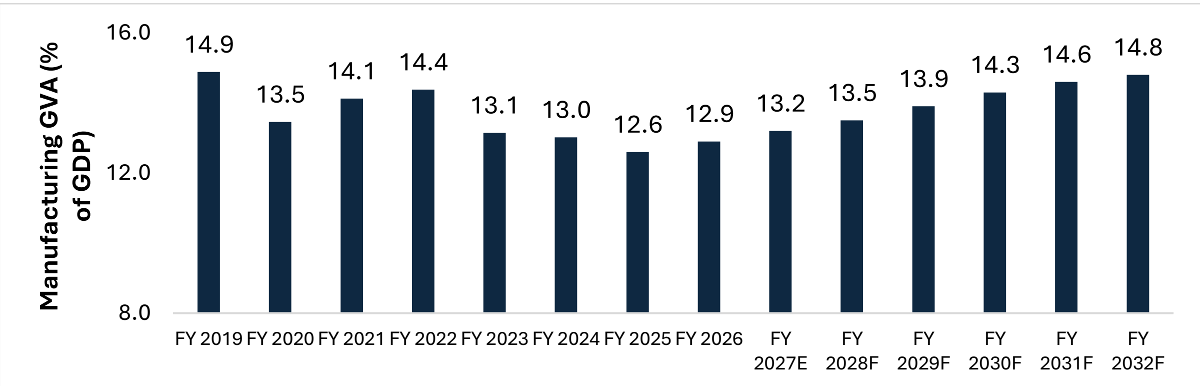
**Exhibit 6: Inflation Rate, India, FY 2019-FY 2032F**




*Note: E: Estimates; F: Forecasts. India's data is represented in fiscal years i.e., FY 2025-26 is the 12-month period between 1 April 2025 and 31 March 2026. Sources: MoSPI; IMF; Frost & Sullivan*

India's share of manufacturing gross value add (GVA) as a % of GDP is forecast to rise from 12.9% in FY 2026 to 14.8% by FY 2032 owing to massive fiscal thrust under the Production Linked Incentive (PLI) schemes to key manufacturing sub-sectors like high-tech manufacturing, automotives, electronics and semiconductors, food and agro-processing, and pharmaceuticals. The nation's long-term vision plan of Atmanirbhar Bharat and Make in India underpin the targeted government focus on the manufacturing sector. Coupled with the infrastructure-led growth model adopted in recent past, manufacturing will remain a key driver of the Indian economy in the long run.

**Exhibit 7: Manufacturing Gross Value-add (GVA) as a % of GDP, India, FY 2019-FY 2032F**

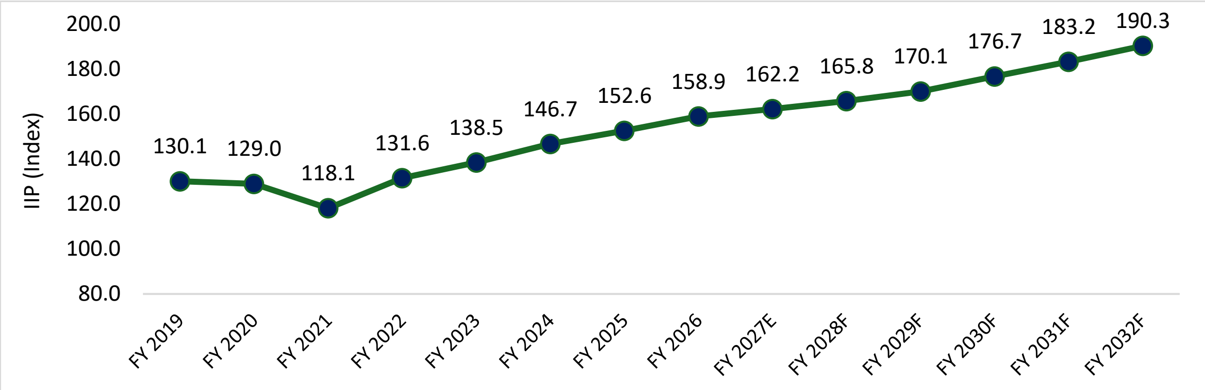



*Note: E: Estimates; F: Forecasts. India's data is represented in fiscal years i.e., FY 2025-26 is the 12-month period between 1 April 2025 and 31 March 2026. Sources: World Bank; Frost & Sullivan*

### 1.3.3 Industrial and Manufacturing Growth – India

Between FY 2019 and FY 2026, India's Index of Industrial Production (IIP) recorded a compounded annual growth rate (CAGR) of 2.9%, driven by favorable demographic trends, growing disposable incomes, and proactive government support. Major growth catalysts included higher government capital expenditure and strategic initiatives such including Rapid mission and the PLI schemes, all designed to enhance domestic manufacturing and promote innovation, positioning India as a leading global manufacturing center.

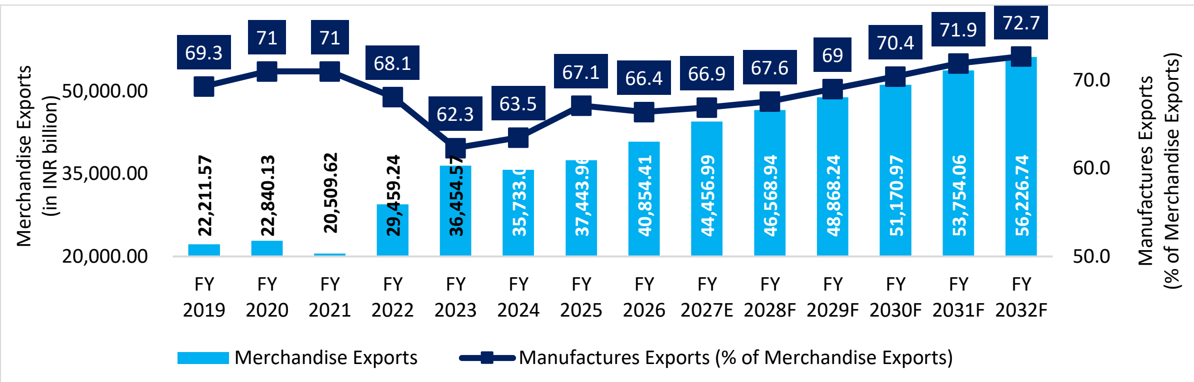
**Exhibit 8: Index of Industrial Production (IIP), India, FY 2019 to FY 2032F**




*Data is represented in fiscal years. For e.g. FY 2025-26 is the 12-month period between 1 April 2025 and 31 March 2026; Source: MoSPI – India, Frost & Sullivan*

Recent trends indicate a notable increase in the manufacturing sub-index, driven by strong consumer demand and recovery across key sectors such as automotive, electronics, and pharmaceuticals. Government focus on digital infrastructure and the adoption of Industry 4.0 technologies is poised to enhance productivity and global competitiveness. Additionally, supportive macroeconomic factors including GDP growth, inflation control, and transformative policies along with a skilled workforce, improved infrastructure, and technological advancements, are reinforcing industrial growth. Trade route disruptions and energy supply disruptions arising from a Strait of Hormuz blockage due to the US-Iran war could lower India's IIP growth in FY 2027 due to higher energy costs and supply chain delays across manufacturing sectors. In mid FY 2027 (Q2 or Q3 CY 2026), as geopolitical conditions stabilize,[7] energy and trade supply chains are expected to normalize, supporting a recovery in IIP growth momentum. Enhanced logistics and the adoption of sustainable, eco-friendly practices are also contributing to a more resilient and long-term economic expansion, attracting greater foreign investment.

**Exhibit 9: Manufacturing Exports (%) and Merchandise Exports (INR billion), India, FY 2019 to FY 2032F**




*E: Estimate; F: Forecast. Sources: World Bank, Frost & Sullivan*

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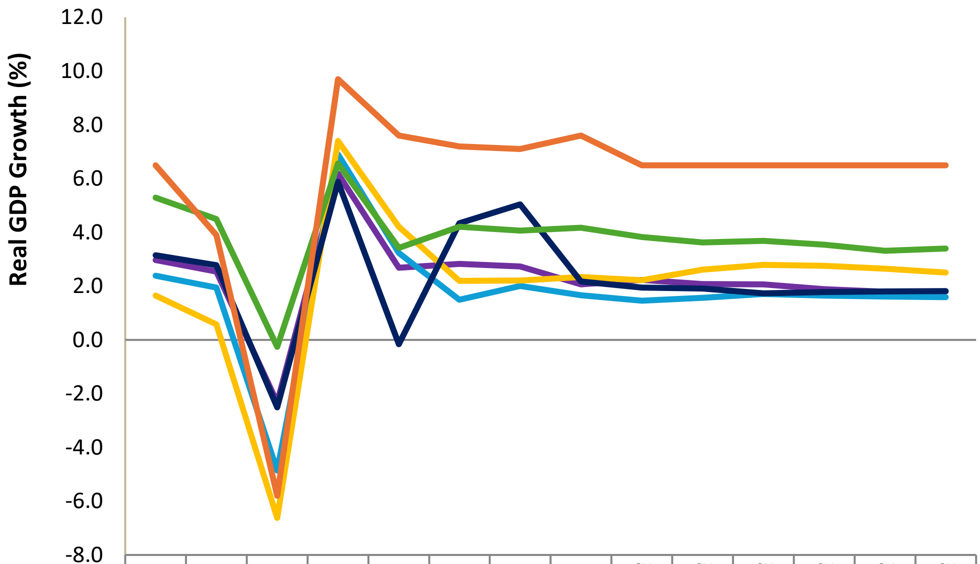
7 The analysis is based on the assumption that US-Iran peace deal will be reached by end of Q2 or in early Q3 2026. This will ensure geopolitical and economic stability being restored in H2 2026.

India's merchandise exports are expected to surpass INR 56,200 billion (USD 590.6 billion) by FY 2032, rising from INR 44,457.0 billion (USD 480.1 billion) in FY 2027, with a projected compound annual growth rate (CAGR) of 4.8%. Between FY 2027 and FY 2032, manufacturing exports are anticipated to contribute ~67–73% of total merchandise exports. Trade route disruptions and energy supply disruptions arising from the Strait of Hormuz blockage due to the US-Iran war, could lower India's merchandise exports and reduce the share of manufacturing in merchandise exports in FY 2027. This will result from higher freight costs, higher energy input costs, and shipment delays on West Asia and Europe bound export routes. In mid FY 2027 (Q2 or Q3 2026), as geopolitical conditions stabilize[8], energy and trade supply chains are expected to normalize, supporting a recovery in export growth and manufacturing trade activity. Manufacturing and merchandise trade growth will largely be fuelled by a development strategy focused on capital investment and manufacturing, actively driven by both central and state governments. Supportive credit environments and significant fiscal incentives for export-oriented industries will further bolster this export expansion.

### 1.4 Regional Growth Figures

The charts below reflect regional GDP growth and India growth for the period of CY 2018- CY 2031.

**Exhibit 10: GDP Growth, Select Regions, and India, CY 2018- CY 2031F**




| | CY 2018 | CY 2019 | CY 2020 | CY 2021 | CY 2022 | CY 2023 | CY 2024 | CY 2025 | CY 2026 E | CY 2027 F | CY 2028 F | CY 2029 F | CY 2030 F | CY 2031 F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North America | 3.0 | 2.5 | -2.3 | 6.2 | 2.7 | 2.8 | 2.7 | 2.1 | 2.2 | 2.1 | 2.1 | 1.9 | 1.8 | 1.8 |
| Europe | 2.4 | 1.9 | -4.9 | 6.9 | 3.2 | 1.5 | 2.0 | 1.7 | 1.5 | 1.6 | 1.7 | 1.7 | 1.6 | 1.6 |
| Latin America | 1.7 | 0.6 | -6.6 | 7.4 | 4.2 | 2.2 | 2.2 | 2.3 | 2.2 | 2.6 | 2.8 | 2.8 | 2.6 | 2.5 |
| CIS | 3.1 | 2.8 | -2.5 | 5.9 | -0.2 | 4.3 | 5.0 | 2.2 | 1.9 | 1.9 | 1.7 | 1.8 | 1.8 | 1.8 |
| Asia-Pacific (excluding India) | 5.3 | 4.5 | -0.3 | 6.6 | 3.4 | 4.2 | 4.1 | 4.2 | 3.8 | 3.6 | 3.7 | 3.5 | 3.3 | 3.4 |
| India | 6.5 | 3.9 | -5.8 | 9.7 | 7.6 | 7.2 | 7.1 | 7.6 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |

*Note: E: Estimates, F: Forecasts. India's data is presented for fiscal years; for example, CY 2025 data refers to data for FY 2026 (April 2025–March 2026) Estimates start from CY 2026. CY 2026 estimates assume that the ongoing Middle East conflict will be short-lived, with a US-Iran peace deal being finalized by late Q2 2026/ early Q3 2026, followed by a trade, infrastructure, and growth normalization in H2 2026. Country coverage for North America GDP growth chart includes the US and Canada. Country coverage for Europe GDP growth chart includes Russia, Germany, Turkey, France, UK, Italy, Spain, Poland, Romania, Netherlands, Belgium, Greece, Czechia, Portugal, Sweden, Azerbaijan, Hungary, Belarus, Austria, Switzerland, Bulgaria, Serbia, Denmark, Finland, Slovak Republic, Norway, Ireland, Croatia, Georgia, Moldova, Bosnia and Herzegovina, Armenia, Albania, Lithuania, Slovenia, North Macedonia, Latvia, Estonia, Cyprus, Montenegro, Luxembourg, Malta, Iceland, Andorra, and San Marino. Country coverage for Latin America GDP growth chart includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Mexico, and Panama. Country coverage for*

[8] The analysis is based on the assumption that US-Iran peace deal will be reached by end of Q2 or in early Q3 2026. This will ensure geopolitical and economic stability being restored in H2 2026.

*CIS GDP growth chart includes Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Uzbekistan, Russia, Tajikistan, Turkmenistan, and Georgia. Country coverage for Asia-Pacific GDP growth includes Australia, Bangladesh, Bhutan, Brunei, Cambodia, China, Fiji, Hong Kong SAR, Indonesia, Japan, South Korea, Singapore, Kyrgyz Republic, Lao P.D.R., Macao SAR, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Philippines, New Zealand, Sri Lanka, Thailand, Vietnam, and Pakistan. Sources: IMF; Frost & Sullivan*

## 1.5 Regional Economic Trends and Outlook

### 1.5.1 North America

Priorities such as localized manufacturing and shorter supply chains have taken centre stage within the region, following the adverse impacts of supply chain disruptions in recent years. The US faces a significant inflation uptick risk in the near-term with the lagged impacts of the tariffs in CY 2025 and early CY 2026 coupled with imported inflation from Middle East disruptions in light of the ongoing US-Iran war. Near-term investment and consumption growth is likely to be impacted, leading to a real GDP growth slowdown in CY 2026. In terms of the monetary policy, the US Fed has put a pause on rate cuts in CY 2026 to ensure effective inflation control. In the baseline, amidst the ongoing geopolitical and supply chain volatility, the Fed is expected to resume rate cuts in late CY 2026/ early CY 2027. However, in case of a prolonged disruption and persistent inflation, the central bank can opt for interest rate hikes in H2 2026.

### 1.5.2 Europe

The protracted Russo-Ukrainian war, uncertainties stemming from US tariff policies, along with energy cost spikes due to the US-Iran conflict and Strait of Hormuz closures are weighing on Europe. The regional real GDP growth is expected to ease from 1.7% in CY 2025 to 1.5% CY 2026 as energy-led inflationary pressures weigh on spending and investments in H1 2026. While sustained fiscal spending, however, will support growth momentum; US trade policy, China demand uncertainty, and Middle East geopolitical conflict remain key regional growth headwinds.

### 1.5.3 Latin America

Stabilization plans – which included eliminations of fiscal and external imbalances led to a contraction of 1.3% in Argentina's CY 2024 real GDP growth. However, agriculture and energy-led exports saw a 4.4% GDP expansion in CY 2025. While Mexico has seen significant benefits from the nearshoring and reshoring trends post-pandemic, high US tariffs on Mexico saw CY 2025 growth at a mere 0.6%, as Mexican exports become less competitive in the US markets.

Colombia's economy expanded by 2.6% in CY 2025. However, imported inflation due to the ongoing Middle East disruptions will see growth softening to 2.3% in CY 2026. In CY 2025, Brazil embarked on monetary policy tightening between September 2024 and May 2025, carrying out an aggressive 425 basis points hike. In CY 2026, cautious interest rate easing has begun, which will help Brazil's annual growth average at 2.0%.

### 1.5.4 Commonwealth of Independent States (CIS)

Russia's growth slowed to 1.0% in CY 2025 as interest rate tightening cooled down consumer demand, however, military spending continues to remain a growth driver. The CIS region, with its CIS Economic Development Strategy 2030, continues to focus on bolstering inter-state trade, building, and strengthening economic co-operation ties, digitalization of economies, and infrastructure development. CIS region's growth is expected to soften from 2.2% in CY 2025 to 1.9% in CY 2026.

### 1.5.5 Asia-Pacific (excluding India)

The Asia-Pacific region remained resilient (compared to advanced regions) in CY 2025 with a real GDP growth rate of 4.2%. Steady domestic demand, tourism rebound, technology, semiconductor, services, and US-tariff driven frontloading being the key drivers. The ongoing Middle East conflict will result in regional growth slowing from 4.2% in CY 2025 to 3.8% in CY 2026, as higher fuel prices result in a direct income and cost shock, curbing household spending as well as driving up production costs for regional manufacturers.

## 1.6 Global Manufacturing Trends & Outlook

### 1.6.1 Supply Chain Shifts Continue amidst China+1 Strategy

Over the past few years, trade wars and falling labor cost-effectiveness have been weighing on China's attractiveness as a go-to manufacturing destination. A realignment in global supply chains amidst rising China+1 strategies is benefitting Asian economies such as India and Vietnam, as global firms are seen moving their manufacturing facilities and diversifying their procurement streams. China will continue to remain a manufacturing leader, while some of these shifts continue over the next few years.

### 1.6.2 Adoption of Industry 4.0

Global manufacturers are accelerating investments in disruptive technologies with a focus on boosting resiliency and agility. Integration of digital technologies like 5G, Artificial Intelligence (AI), Machine Learning (ML), big data, Internet of Things (IoT) into the manufacturing processes remains steadily underway within industries, armouring firms with capabilities to make strategic decisions based on real-time data collection and analysis.

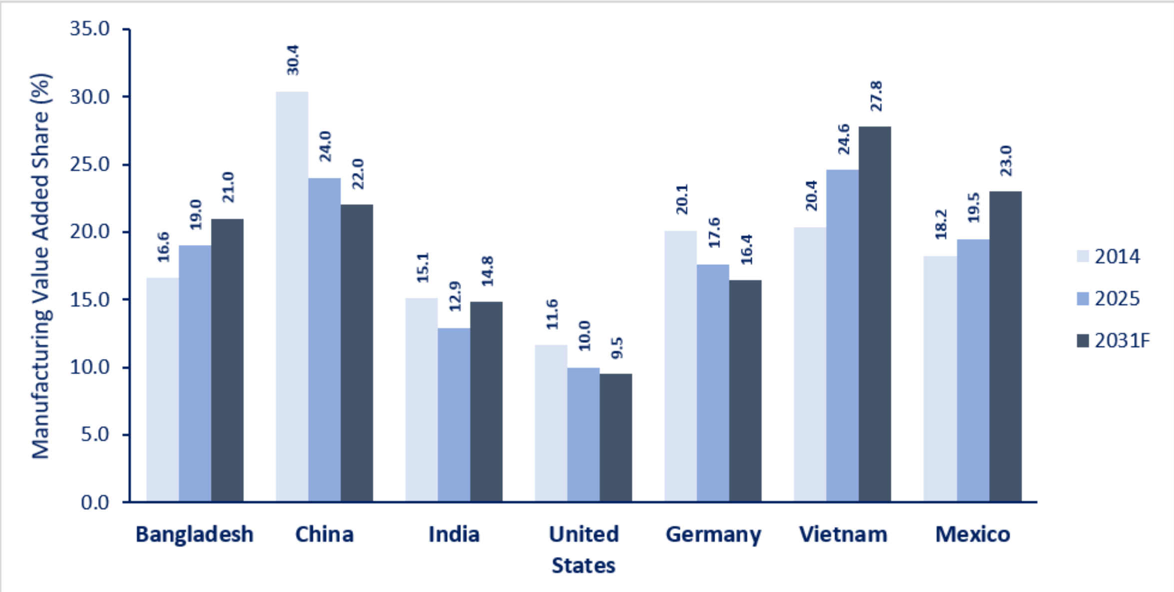
### 1.6.3 Rise of Sustainable Manufacturing

Sustainability is taking a centre stage amidst not only global decarbonization commitments, but also as companies see thinning profit margins and high insurance costs as the key downsides of adverse climate change events and persistent supply chain snarls. Increasingly, companies are adopting circular economy principles, which is helping them establish restorative industrial systems. As the linear manufacturing production streams rapidly transform given rising adoption of sustainability, superior design of materials is boosting product quality and fostering adoption of renewable energy solutions, restoration processes, and elimination of toxic chemicals.

## 1.7 Global Comparison of Manufacturing Shares

The chart below compares manufacturing sector contribution to GDP across various economies.

**Exhibit 11: Manufacturing Value-add as a % of GDP, Select Economies, CY 2014, 2025, and 2031F**




*Note: India's data is presented for fiscal years; for example, 2025 refers to data for FY 2026 (April 2025–March 2026). 2025 data for all countries is estimated. Note: F: Forecasts; Source: World Bank; Frost & Sullivan*

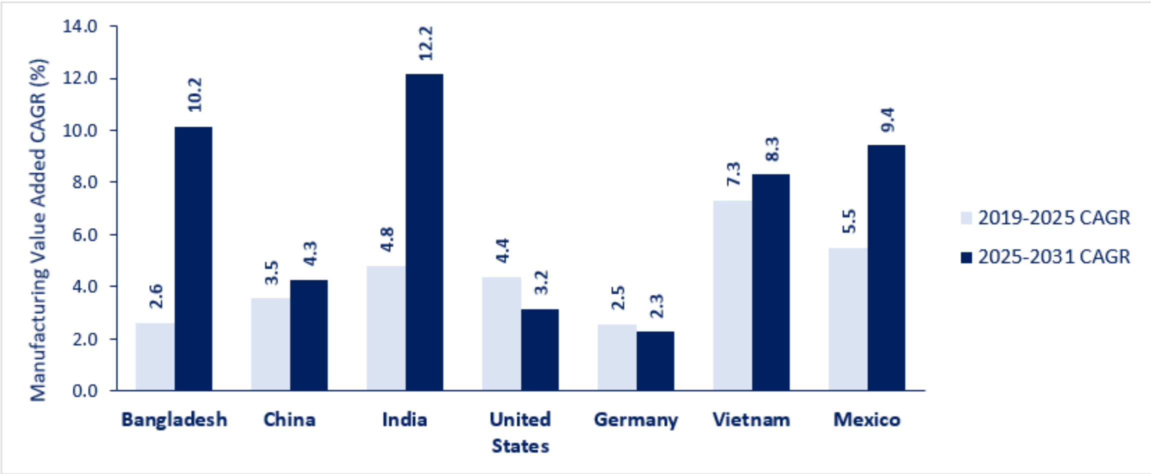
Between CY 2025 and CY 2031, developed countries like United States and Germany are expected to see a fall in the share of manufacturing sector. However, focus on building domestic capabilities to insulate economies from external shocks amidst post-pandemic supply chain disruptions will see investments into localized manufacturing.

Emerging markets such as Vietnam and India are likely to be the biggest beneficiaries of foreign manufacturing investments amidst factors such as the China+1, friendshoring, and nearshoring strategies. However, the ongoing Middle East disruptions and the resultant energy price spikes and supply chain disruption remain a near-term risk to outlook.

## 1.8 Global Comparison of Manufacturing Growth

The chart below evaluates the growth of the manufacturing sector for the CY 2019- CY 2031 period.

**Exhibit 12: Manufacturing Value-add, Select Economies, CY 2019-2031F**




| Manufacturing Value-add (Current USD) | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026E | 2027F | 2028F | 2029F | 2030F | 2031F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bangladesh | 74.5 | 77.0 | 88.4 | 100.1 | 97.7 | 98.5 | 87.0 | 107.2 | 113.3 | 120.6 | 130.6 | 142.2 | 155.4 |
| China | 3823.4 | 3860.7 | 4909.0 | 4840.0 | 4658.8 | 4661.4 | 4710.3 | 4921.0 | 5087.5 | 5256.8 | 5475.1 | 5730.3 | 6049.3 |
| India | 381.6 | 377.7 | 455.4 | 439.9 | 473.7 | 493.3 | 505.2 | 548.2 | 618.2 | 703.2 | 800.7 | 901.3 | 1005.3 |
| United States | 2381.9 | 2269.7 | 2536.3 | 2684.5 | 2840.4 | 2913.1 | 3076.7 | 3238.4 | 3311.4 | 3401.4 | 3490.6 | 3579.4 | 3708.0 |
| Germany | 764.1 | 730.0 | 807.6 | 762.8 | 857.2 | 839.1 | 888.5 | 943.3 | 959.2 | 960.8 | 977.7 | 984.0 | 1016.8 |
| Vietnam | 79.5 | 83.0 | 89.6 | 102.4 | 104.9 | 116.4 | 121.5 | 131.8 | 144.9 | 157.6 | 173.5 | 185.6 | 196.1 |
| Mexico | 259.4 | 226.3 | 274.3 | 315.1 | 366.3 | 366.9 | 357.4 | 413.6 | 444.4 | 512.0 | 550.5 | 586.2 | 613.5 |

*Note: E: Estimates and F: Forecasts. India's data is presented for fiscal years; for example, 2025 data refer to data for FY2026 (April 2025–March 2026). 2025 data for all countries is estimated. Source: World Bank; Frost & Sullivan*

Looking at historical data, the compound annual growth rate (CAGR) of manufacturing value-add (current USD) for advanced economies such as Germany stood at 2.5% (CY 2019 – CY 2025). On the other hand, India's and Vietnam's manufacturing growth was at 4.8% and 7.3%, respectively, between CY 2019 – CY 2025. In part, this is reflective of the stages of economic development within these countries with advanced economies tending to exhibit lower manufacturing growth as they are at a more advanced stage of development. For Vietnam, some of this manufacturing growth can also be attributed to the redirection of investments towards Vietnam, following the outbreak of US- China trade wars in 2018.

China's CY 2019- CY 2025 manufacturing value-add CAGR stood at 3.5%, compared to India's 4.8%. Moreover, over the CY 2025- CY 2031Forecast period, India's manufacturing CAGR will significantly exceed China's, with 12.2% and 4.3% growth rates, respectively. This is reflective of the diversification of manufacturing investments beyond China as well as India's success in attracting more manufacturing investments on account of the PLI scheme, an overall business friendly policy climate, and robust GDP growth. Similarly, Vietnam will also see high CY 2025- CY 2031 CAGR growth rates of 8.3%, driven by supply chain diversification and local policy initiatives.

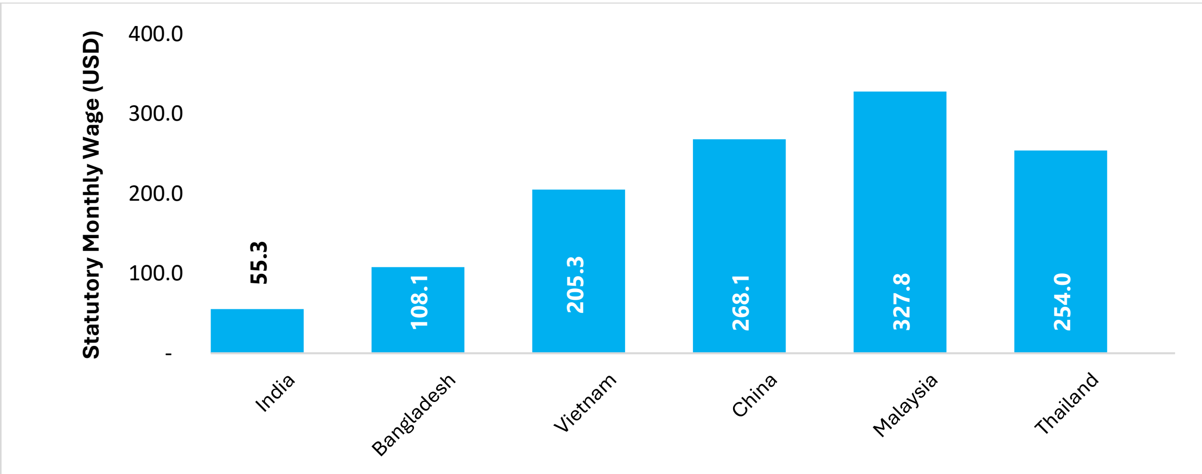
### 1.8.1 India's Strong Growth Path: Robust Manufacturing and Exports Growth Potential

Factors such as demographic dividend, conducive state and central government policies, exports, adoption of manufacturing and infrastructure-led growth model, availability of a vast and skilled workforce are the key factors underpinning India's potential to become an exports and manufacturing hub.

- **Robust Public Investment Driving Manufacturing Growth:** India's manufacturing expansion is underpinned by rising public capital expenditure, set to grow from INR 3.1 trillion in FY 2019 to INR 12.2 trillion by FY 2027 (18.7% CAGR). Initiatives like Make in India, Atmanirbhar Bharat, and the PLI scheme have attracted global firms such as Apple and Boeing. As of December 2025, USD 22.9 billion (INR 2.2 trillion) have been invested under the PLI schemes, with 836 applications clocked across 14 sectors. As a result, manufacturing value-added (as % of GDP) is projected to reach 14.8% by FY 2032, while merchandise exports (of which 67-73% are accounted for by manufacturing), are expected to rise from INR 40.9 trillion to INR 56.2 trillion between FY 2026 and FY 2032.

- **Manufacturing – a Critical Growth Driver**: India has embraced a growth model focused on manufacturing, aiming to create a cost-effective local production ecosystem and enhance export capabilities. Key policy initiatives like Make in India, Atmanirbhar Bharat, Rapid Mission, Industrial Corridor Development Programme, and PLI schemes will continue to play crucial roles in driving manufacturing growth. Coupled with rapid infrastructure and digital transformation, India's manufacturing GVA will edge closer to ~15% of the GDP by the end of this decade, compared to 12.9% in FY 2026. Moreover, India's gross expenditure on R&D has more than doubled between 2010-11 and 2020-21, surpassing INR 1.3 trillion by 2020-21. This boost in innovation spending is fostering rapid technological shifts and further strengthening India's high value add manufacturing capabilities.
- **Infrastructure Boom and Geographic Advantages**: The Indian government has adopted a capex and infrastructure-led growth model in recent years. For instance, USD 16.3 billion (INR 1.4 trillion) have been earmarked for PM Gati Shakti infrastructure plan to boost logistics and connectivity. Moreover, India's geographic location is a strategic advantage, with established shipping routes enhancing India's access to markets in Asia, the Middle East, Europe, and Africa. The country has over 200 ports and 137 airports (21 international and 10 customs airports). Factors such as a sizable policy impetus, especially for infrastructure and logistics, combined with proximity to end-user markets, are driving India's emergence as a preferred destination for precision component manufacturing.
- **Availability of Affordable Talent Pool and Workforce Skilling**: Based on figures from the International Labour Organization (ILO), statutory monthly minimum wages in the manufacturing industry are relatively low across key Asian countries - USD 268.1 in China, USD 327.8 in Malaysia, USD 254.0 in Thailand, USD 205.3 in Vietnam, USD 108.1 in Bangladesh, and USD 55.3 in India (as of CY 2024), highlighting the cost advantage these nations offer in terms of labor. Improved skilling and industry-oriented education are boosting productivity in electronics, automotive, and green energy sectors. India remains relatively cost competitive in terms of labor, supporting the viability of labor-intensive manufacturing compared to several other countries.

**Exhibit 13: Statutory Monthly Minimum Wage, USD, Select Countries, CY 2024**




*Sources: ILO, Frost & Sullivan*

- **Demographic Dividend and Large Workforce:** India's sizable share of young and working age population remains central to manufacturing growth. India had a median age of 28.4 years in CY 2024, significantly younger than China at 39.6 years and Europe at 42.5 years. Additionally, India's relatively higher fertility rates are expected to sustain the growth of its young and working-age population, with the share of 15–59-year-olds forecast to surpass 65.1% by CY 2030, compared to 61.4% in CY 2011. India's labor force (economically active population aged 15 years and above) stood at 617.6 million in CY 2025 significantly higher than peers such as Bangladesh (74.7 million) and Vietnam (57.0 million). While China's labor force at

767.6 million was larger than India's in CY 2025, China's rapidly aging and shrinking population is a key restraint. A steady economic growth momentum coupled with an expanding workforce are positioning India as a go-to manufacturing destination.

- **RBI's Regulatory Pivot Supporting Seamless Trade**: In August 2025, the RBI announced that the Special Rupee Vostro Accounts (SRVAs) – which are used by local importers for settlement of trade obligations – will no longer need approval and can be directly opened by the Authorized Dealer (AD) banks. This will not only enable seamless cross-border transactions but also reduce import and delivery timelines for manufacturers as regulatory burdens ease. This move comes under the RBI's targeted efforts to boost the use of Indian rupees (INR) for international trade transaction settlements. Currently, 22 countries including nations like UAE, Russia, the UK, Germany have provisions for SRVAs, enabling trade in INR.
- **Promising Export Potential**: India aims to achieve USD 2 trillion in exports by 2030 under its 2023 Foreign Trade Policy – which targets to build conducive ecosystems for exporters, foster exports through collaboration, and accelerate duty refunds. Factors such as access to a vast talent pool, affordable labor costs, manufacturing economies-of-scale, rapidly developing transportation and multi-modal logistics, and a business-friendly regulatory environment will be critical enablers of India's exports competitiveness. Furthermore, the development of Special Economic Zones (SEZ), expanding export incentives, and a strong digital infrastructure will spur India's exports and trade transformation.

### 1.9 Global Policy Support for the Manufacturing Sector

Below are the key manufacturing sector policy initiatives for select few major economies.

- **European Union (EU)**:
  - Under the Horizon 2020 program, the "Made in Europe" public private partnership program with a budget of USD 1.9 billion was launched for the period of CY 2021- CY 2027.[9] 3D-printing projects have also been receiving steady support from the Horizon Europe research program, with the latest USD 7.2 million project funding being rolled out for the MADE-3D project in March 2023.
  - The European CHIPS Act (introduced in September 2023) will have a USD 46.5 billion investment outlay to boost EU's production capacity to 20% of the global market by CY 2030, compared to 9% in CY 2023.
  - The European Commission Net Zero Industry Act supports domestic clean technology manufacturing including batteries, solar, hydrogen, and carbon capture. It entered into force in 2024 and targets at least 40% EU domestic manufacturing capacity for strategic net zero technologies by CY 2030.
  - Rolling investments and policy support for the additive and advanced manufacturing sectors will establish a conducive investment climate for global manufacturers in the respective industries.
  - Under the Readiness 2030 Plan (announced in CY 2025), the EU plans on boosting the defence spending to 1.5% of GDP annually over the next 4 years. The rising fiscal support for the defence comes in light of the protracted Russo-Ukrainian war and geopolitical tensions with the new US administration.

- **United States**:
  - In CY 2025, the Trump administration pursued an aggressive onshoring agenda underpinned by deregulation and the "One Big Beautiful Bill," which reinstated bonus depreciation for qualifying manufacturing equipment and restored R&D deductions. It incentivised major investment commitments spanning automotive, pharmaceuticals, and aerospace sectors.[10]
  - In CY 2025, the Department of Labor awarded over USD 86 million in Industry-Driven Skills Training Fund grants to 14 states to train workers in AI infrastructure, advanced manufacturing, aerospace, and defence, while the Economic Development Administration set aside an additional USD 25 million to support workforce initiatives tied to the AI Action Plan and the broader domestic tech manufacturing buildout. By deepening the talent pipeline for high-skill industrial occupations, these investments are designed to directly support the labour capacity needed to sustain and scale domestic tech manufacturing across critical sectors.

[9] European Commission
[10] The White House

- **India**:
    - In March 2020, under the flagship Aatmanirbhar Bharat Abhiyaan, the PLI scheme was announced with an aim of building India's local production and manufacturing capacity. As of December 2025, 836 applications were accepted across 14 sectors. Along with a realized investment of USD 22.9 billion (INR 2.2 trillion), 14.4 lakh jobs have also been generated.[11] Industries such as electronics, pharmaceuticals, telecom, food, automobiles and auto components, textiles, specialty steel, medical devices etc. have been some of the key beneficiaries. Under the FY 2027 Union Budget, (INR 15,541 crore) was earmarked for PLI schemes.
    - Along with the PLI schemes, the National Manufacturing Mission (announced in FY 2026 Union Budget) is expected to support USD 46.5 billion (INR 4 trillion) worth of turnover and USD 12.8 billion (INR 1.1 trillion) in exports. Similarly, PM Gati Shakti, with its logistics and infrastructure-centric spending support, India continues to lay a strong foundation to become a go-to manufacturing hub.
    - India Semiconductor Mission supports semiconductor fabrication, packaging, and electronics manufacturing. While India Semiconductor Mission 1.0 was launched in FY2022 with a fiscal outlay of approximately USD 7.9 billion (INR 760 billion), the Union Budget FY 2027 announced the launch of ISM 2.0 with a budget provision of approximately USD 104 million (INR 10 billion) for FY 2027.
    - The 2022 National Strategy for Additive Manufacturing will focus on attracting global additive manufacturing (AM) players to set up domestic production by building a stable and efficient ecosystem for design, development, and deployment and positioning India as an AM industry hub.
    - With the target of becoming a USD 5 trillion economy by FY 2028, the Indian government is set to launch the Rapid (Research, Analysis, Programme Implementation, and Data Intelligence) mission, which will incentivize R&D within the private sector and boost the manufacturing value add to national GDP.

### 1.10 Top Macroeconomic Takeaways [12]

1. **Geopolitical and Trade Tensions to Slowdown CY 2026 Growth:** The US-Iran war and related geopolitical uncertainty, including the Strait of Hormuz trade disruptions, are expected to increase inflationary pressures through higher energy prices and supply chain disruptions, while also slowing private investment growth due to global business uncertainty. Against this backdrop, global real GDP growth is expected to moderate from 3.4% in CY 2025 to 3.1% in CY 2026.
2. **Emerging Markets to Drive Global Expansion:** While the advanced economies are projected to grow at 1.8% in CY 2026, the emerging and developing economies are likely to witness 3.9% growth. India (6.5%) and Vietnam (7.1%) are expected to outperform, fuelled by strong domestic demand and continued manufacturing and export sector expansion.
3. **Diversification and Regionalization of Trade and Supply Chains to Gain Traction:** Amid ongoing trade disruptions and geopolitical instability, manufacturers will continue diversifying supply sources. Global manufacturers are increasingly turning to reliable Asian partners like India, while Gulf economies such as the UAE and Saudi Arabia are attracting investment through active economic diversification strategies.
4. **India Set to Sustain Its Growth Leadership:** Following robust annual average growth of 7.8% from FY 2022 to FY 2026, India is expected to grow at 6.5% in the next two fiscal years (FY 2027 and FY 2028). With this trajectory, India is poised to become the world's third-largest economy by CY 2031. In contrast, the US and China are forecast to witness an annual average growth of 2.0% and 3.8%, respectively, between CY 2026 and CY 2031.
5. **India Strengthens Its Role as a Manufacturing Hub:** India's policy initiatives, such as the PLI scheme, along with a large, cost-effective workforce, are boosting its appeal as a key China+1 manufacturing destination. The country's manufacturing GVA as a share of GDP is projected to rise from 12.9% in FY 2026 to 14.8% by FY 2032, signalling growing investor confidence. India's manufacturing GVA will grow at a CAGR of 12.2% between CY 2025 and CY 2031.

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[11] Indian Ministry of Commerce and Industry

[12] 2026 growth performance is contingent on the outcomes and developments of the Middle East conflict. In the baseline scenario, we expect that the US-Iran peace deal is expected to be signed in late Q2 or Q3 CY 2026, following which the associated trade, supply chain, and energy disruptions are expected to gradually ease during H2 CY 2026.

## 2. Overview of Global MIM Market

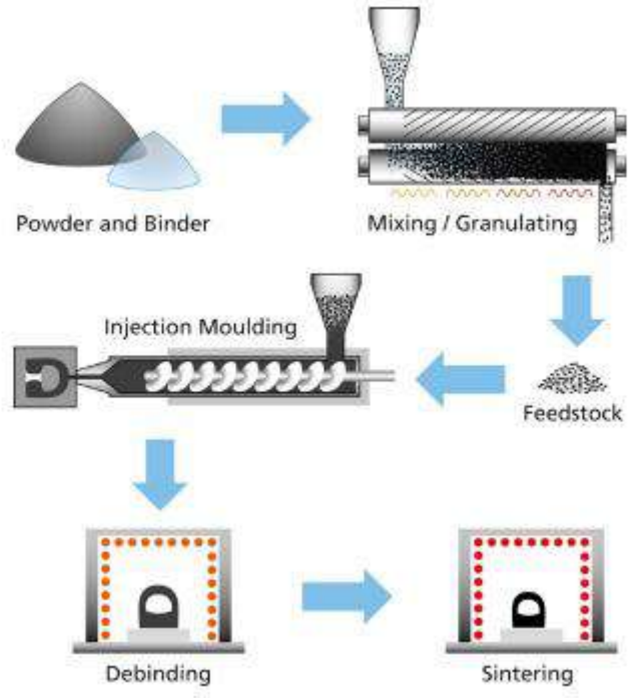
### 2.1 Market Definitions and Segmentation

**Introduction**

- Metal injection molding can produce relatively small, highly complex geometries with excellent surface finish, high strength, and superior corrosion resistance. The typical tolerance for metal injection molding (MIM) is ±0.3% to ±0.5% of the dimension, with an average tolerance of ±0.003 in (±0.076 mm) per inch of dimension. However, tolerances can vary depending on several factors, including part geometry, material selection, and processing conditions.
- Metal injection molding (MIM) primarily uses a thermoplastic binder and metal powders. The binder is only a processing aid and is removed from the product after the injection molding process
- The binder and metal powder are mixed using a kneader or shear roll extruder, after which the powdered mix is again worked on to a plastified binder (**plastified binder** = binder converted into a **plastic-like, moldable medium** that locks the powder into a homogeneous feedstock). Currently, there are ready-to-mold feedstock available in the industry. Most component manufacturers develop their feedstock in- house according to manufacturing requirements.
- "Metal Injection Molding" excels at applications that require shape complexity and material properties (high strength, magnetic permeability, and corrosion resistance) that cannot be fulfilled by plastic and light metal alloys. It offers tremendous single-step parts consolidation potential that makes it a competitive alternative to stamped/machined-parts assemblies. Many design and economic limitations of traditional metalworking technologies can be readily overcome by MIM.

**Exhibit 14: Metal Injection Molding Process**

A schematic showing the basic steps of the metal injection molding (MIM) production process




*Source: IFAM; Frost & Sullivan*

**Injection Molding**

- Using high pressure, the heated feedstock is injected into the component mold cavity.
- The process has a very short cycle time and enables industries to manufacture components with extremely complex geometry.

- The molded components are referred to as ‘green’ parts and are generally 20% larger than the final finished product, which shrinks during the final sintering phase.

### Debinding (Binder Removal)

- In this step, the binder is removed in a controlled manner, without damaging or destroying the shape of the component. The debound component is called ‘brown’ and is ready for the final sintering process. Depending upon the design and geometry, the cycle time for removal of the binder might vary.

### Sintering

- ‘Brown’ is normally very fragile and held together by the remaining binder material. The sintering process is the last step of MIM where the remaining binder material generally present in the component pore volume is removed.

- When the remaining binder is removed, ‘brown’ undergoes shrinkage to the extent of volume percentage of binder used (approx. 15% to 20%), and the final/finished component is obtained

| Process Step | Typical Cost Share (%) | Notes |
|---|---|---|
| Metal Powder + Binder (Raw Materials) | **35–50%** | Fine metal powders (e.g. stainless steel, Ti, Ni alloys) are very costly; binder is smaller fraction (~3–5%). |
| Feedstock Preparation (Compounding) | **5–10%** | Mixing powder & binder into homogeneous feedstock pellets. |
| Injection Molding | **10–20%** | Machine time, tooling amortization, labor, cycle time. |
| Debinding | **5–10%** | Solvent or thermal; energy-intensive but not as costly as sintering. |
| Sintering | **15–25%** | Largest processing cost driver after raw material; requires high temp. |
| Post-processing / Finishing | **5–10%** | Machining, surface finishing, coating, QA. |
| Overhead / Indirects | **5–10%** | Tooling amortization, scrap, utilities, SG&A |

## 2.2 Advantages of Metal Injection Molding

- Metal Injection Molding (MIM) enables mass production of complex metal parts with intricate geometries and precise tolerances. It's ideal for creating large quantities of small, detailed metal components with high accuracy. MIM is widely used for producing complex metal structures in high volumes
- Injection molds can cost anywhere between USD 10,000 to USD 100,000, depending on part complexity, and other considerations. The tool cost makes Metal Injection molding costlier to set up but is less expensive in the long term as we can continue to make very high production volumes using the same mold.
- Without the need for additional machining and fabrication steps, in most cases MIM can precisely generate features such as internal and exterior threads, undercuts, teeth (such as gear teeth), slots, holes, fins, markings, and engravings.
- MIM can create multi-component parts from a single piece and from a single mold.

### Design Freedom

- Metal Injection molding offers immense design freedom and complexity. The technology allows various industries to manufacture complicated parts, such as cross holes, angle holes, splines, undercuts, side holes, and grooves.

- Geometrically complex parts that cannot be produced using conventional powder metal processes are made using the MIM process.

### Improved Physical Properties

- High Density: MIM parts reach 95–99% of theoretical density, much higher than conventional powder metallurgy, giving them near-wrought properties.
- Superior Strength & Fatigue Resistance: High density and uniform microstructure deliver strength and fatigue life comparable to wrought alloys.
- Hardness & Corrosion Resistance: Heat-treatable steels achieve 50–60 HRC hardness, while stainless MIM parts retain excellent corrosion resistance.
- Fine Surface Finish: Smooth surfaces (Ra ~1–2 µm) and uniform properties without secondary machining.

### Reduced Wastage

- Unlike other conventional manufacturing processes, such as stamping, MIM does not cut the component from a metal block or sheet; as a result, wastage is as low as 3% or even lower. This also reduces the cost of energy used.
    - Stamping typically generates 20-30% material waste, sometimes up to 50% or more, depending on part geometry and material utilization.
    - Machining: 50-90% (depending on part complexity and material removal)
    - Die Casting: 5-20% (depending on gating system and part design)
    - Casting: 5-50% (depending on riser and gating system design)
- The manufacturing process uses only the precise quantum of materials that is required to produce a component of high density as it is a near net shape technology.
- As the manufacturing process also can provide net shape for the components, the requirement for secondary machining or surface finishing is minimized, thereby reducing overall material wastage.

### Highly Cost-effective

Here are some key points about Metal Injection Molding (MIM) with statistics:

- Shorter production cycle time: MIM has a shorter production cycle time compared to conventional techniques like die casting or stamping, resulting in higher productivity.
- Cost-effectiveness: MIM is 30-50% more cost-effective than traditional machining methods for complex parts.
- Material efficiency: A well-designed MIM part can reduce material waste by up to 97% compared to traditional machining methods.
- Low component cost: The cost of MIM components is typically only 10-20% of the total cost of the final product, making it an attractive option for high-volume manufacturing of complex parts

### Reduced Assembly

- One of the major advantages of MIM is that the process can be used to combine two or more simpler shapes of a component into a single, more complex part and minimize assembly costs. Complex features/minute details often need secondary machining, but these can be usually obtained directly from the Metal injection molding process, without additional operations.

- Metal injection molding is widely used in the production of automotive components such as rocker arms, turbocharger vanes, shift levers, seat components, brake components, injector nozzles, light housings, and numerous fittings and connectors because MIM enables near-net-shape manufacturing of complex geometries, which reduces the number of moving or assembled parts needed in the final component.
- Highly dense components manufactured using MIM mostly require minimal machining, surface finishing, and do not require assembly further down the production line.
- MIM can efficiently work with new emerging technologies (e.g., 3D printing). MIM will benefit from faster prototyping, which is covered in the later sections in detail.

### 2.3 Benchmarking MIM with Other Conventional Technologies

**Exhibit 9: MIM vs. Machining, Die Casting, Stamping, & Powder Metallurgy**

| Method | Method Limitation | MIM Advantage |
|---|---|---|
| **Machining** | • High-level wastage<br>• Design Limitation<br>• Not suitable for intricate design | • Almost no material waste<br>• Excellent for intricate components<br>• MIM allows the same design freedom as plastic injection molding and provides almost limitless shape capability |
| **Die Casting** | • Lower mechanical properties<br>• Needs higher level of machining and hence repeatability goes down<br>• Inefficient to handle high volumes<br>• Limited range of materials | • Excellent mechanical properties<br>• Wide range of materials<br>• Easy replacement for producing extremely small components rather than using significant finish machining or assembly processes. |
| **Stamping** | • Slow, labor-intensive process<br>• Tolerance, hard to control<br>• Many secondary operations<br>• Expensive equipment and process | • Low cost associated with manufacturing<br>• Shorter production cycle<br>• Excellent surface finish<br>• Minimal secondary operations |
| **Powder Metallurgy** | • Lower densities<br>• No complex shape<br>• Many secondary operations | • Perfect for manufacturing high-density components<br>• Produces high-volume fabrication of small, geometrically complex parts. |

*Source: Frost & Sullivan*

- **Metal Injection Molding** allows casting of tiny, complex parts, producing net shape, and complex metal parts in large quantities. It is a great alternative to machining or casting, and its other technical advantages are superior density, zero corrosion, strength, and ductility.
- **Powder Metallurgy** (PM) covers a wide range of materials; components are made from metal powders. PM processes can reduce the need to use metal removal processes, thereby drastically reducing yield losses and often resulting in lower costs.
- **Die Casting** have higher weight ranges (10 kg or above), depending upon the application. It is primarily used in automotive castings, such as wheels, engine mounts, brackets, and engine/gear box casings.
- **Machining** is the secondary-but-crucial operation, as it is the final process of finishing, after the raw cast product is produced. Each of the parts requires machining, which adds 10%–20% to the cost, depending on the complexity of the product.

- **Stamping** operation is a voluminous process for less complex parts. It is the process of placing flat sheet metal, in either blank or coil form, into a stamping press where a tool and die surface forms the metal into a shape depending upon customer requirements. Stamping includes a variety of sheet-metal forming manufacturing processes, such as punching (using a machine press or stamping press), blanking, embossing, bending, flanging, and coining.
- **Feedstock**: When the powder and binder are combined, the result is a homogeneous mixture that may be molded. The feedstock is considered when designing the tool cavity, which also takes the feedstock's viscosity, strength, and particle size into account. When the hot feedstock viscosity is close to 100 PaS (1000 poise), the best molding is possible. As a comparison, this is thicker than most paints (which are composed of tiny oxide particles dispersed in a binder made of cellulose or gum dissolved in water), more like toothpaste (which also contains tiny oxide particles in a binder), but not as thick as cold ice cream. Pellets made from a standard feedstock are correctly designed to feed into an injection molding machine. Companies like Indo-MIM can retain excellent quality and maximum flexibility by manufacturing their own MIM feedstock. In a well-controlled environment, precise and error-proof batch manufacturing of powders and binders is performed. To turn the combination into a consistent, high-quality feedstock, batch and continuous compounding devices are used. The mixing procedure and material properties are constantly monitored.

**Exhibit 10: Technology Comparison of MIM with Other Conventional Technologies**

| Parameters | Metal Injection Molding | Powder Metallurgy | Die Casting | Machining | Stamping |
|---|---|---|---|---|---|
| Tensile strength | ● | ◐ | ◐ | ● | ● |
| Surface finish | ● | ◐ | ◕ | ● | ● |
| Miniaturization | ● | ◔ | ◐ | ◕ | ◔ |
| Thin wall capability | ● | ◔ | ◕ | ◐ | ◔ |
| Complexity | ● | ◐ | ◕ | ◕ | ○ |
| Design flexibility | ● | ◐ | ◐ | ● | ○ |
| Production quantity | ● | ● | ◐ | ◐ | ● |
| Range of materials | ◕ | ◔ | ◔ | ● | ◔ |
| Density | ◕ | ◐ | ◕ | ● | ● |

| | | | | | |
|---|---|---|---|---|---|
| Cost | ◐ | ◔ | ◕ | ◕ | ◔ |
| Tolerance | ● | ◐ | ◕ | ● | ◕ |
| Wastages | ○ | ◐ | ◐ | ● | ◕ |
| Need for secondary processes | ◔ | ◕ | ◕ | ● | ◕ |

* Harvey balls of Empty: Low; Full: High; Half: Medium; ¾: Medium to High; 1/4: Low to Medium

### 2.4 Overview of Conventional Manufacturing Technologies

In traditional powder metallurgy, the metal powder is irregular in shape and pieces come in larger sizes, this is due to the water atomization process. Powder metallurgy process involves following steps as discussed below

1. Begin with blending or mixing specific types of metal powders and lubricants.
2. Place the mix in a die to create a certain shape.
3. Use a press to compact the metal powder tightly.
4. Sinter the compressed part in a furnace to form metallurgical bonds in the metal powder.

**Here are examples of parts manufactured through Traditional Powder Metallurgy**

| Segment | Key Components | | |
|---|---|---|---|
| Automotive: | Engine & transmission gears | Connecting rod caps | Valve seat inserts |
| General engineering: | Porous bearings/bushings (self-lubricating) | Filters (bronze/steel) | Structural components (iron-based) |
| Hand tools & hardware: | Lock components | Small brackets & housings | |

The mass manufacturing of powder metal parts has been in force for over 100 years. It's used to make a wide variety of parts of different shapes and sizes, ideal for a host of automotive and other applications.

Although the powder metallurgy technique is relatively cost-effective for very particular geometries (ie., Axisymmetric parts, simple prismatic shapes, Holes and slots aligned with the pressing direction, uniform wall thickness, shallow external features), it does have restrictions because of tool motion. One specific restriction is the lack of side action for undercut features. This would be one justification for a client to favour MIM for a particular application.

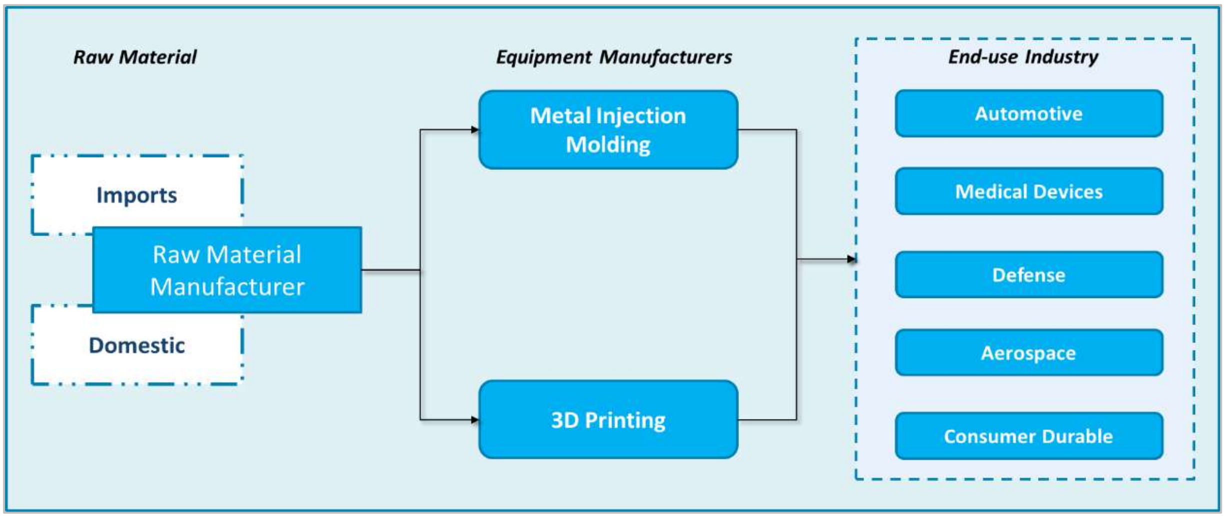
Metal injection molding (MIM) is a key industrial process within the broader category of powder injection molding, which also includes ceramic injection molding. The MIM industry is driven primarily by five major sectors: automotive (29%), defence (34.5%), consumer goods (12%), aerospace (2.5%), and medical devices (17%), accounting for approximately 95% of the market. MIM components are utilized in a diverse range of products, including automobiles, smartphones, watches, medical equipment, household appliances, cameras, power tools, and defence components.
Regional variations are notable, with Asia dominated by consumer electronics, North America by dental and orthodontic applications as well as firearms, and Europe by automotive and consumer goods. MIM is preferred over traditional manufacturing processes for complex, high-volume parts due to its efficiency and precision.

Although creating a mold can be time-consuming, repeat production using the mold significantly reduces turnaround times for small, intricate parts. For example, some MIM parts can weigh as little as 15 grams. The MIM process also minimizes waste, reduces processing time, and eliminates the need for secondary operations.

MIM is widely used in the production of complex components for the automotive, defence, medical device, and aerospace industries. The metal injection molding process provides the ability to manufacture a variety of materials such as stainless steel, tungsten alloys, special materials like titanium alloys with mechanical properties that are near equivalent or in some cases exceed wrought or cast processes. Due to the use of fine metal powders, MIM parts are generally limited in size and weight. However, the high initial costs associated with mold manufacturing are a significant consideration. MIM parts are typically limited to **<100 g weight and ~10 cm size**, best suited for small intricate geometries. However, **tooling costs ($15k–75k)** are high, making MIM economical only at **100k+ production volumes**.

## 2.5 Value Chain Assessment

**Exhibit 11: Metal Injection Molding Industry Value Chain**




*Source: Frost & Sullivan*

The demand of high productivity, high precision and complex geometries initiated the development of metal injection molding. In the first phase, metal powder and binder are combined to form a feedstock. In the second phase, the feedstock is injected into a Mold with specific geometry. The resulting product is referred to as the green part. The binder is then removed from the green component by solvent and thermal debinding. The metal powder particles join together during the subsequent sintering stage, causing densification and shrinking of the component. While some companies use premix compounds, and some go through the elemental way i.e. mixing powders and binders in the required proportion. While premix compounds eliminate one step in the MIM manufacturing process, it brings in its own limitations on the design and shrinkage side. Elemental way gives freedom for the companies on the design front though it adds one more step to the manufacturing process. Indo-MIM is the premier MIM manufacturer with the capability of producing its own feedstock through the elemental way thereby giving it a total freedom on the design front.

Currently, OEMs are shifting to global platforms and consolidating their supplier bases to capture greater total value content in individual programs. Business relationships in the precision components manufacturing industry are characterized by a high rate of repeat orders and minimal inclination by OEMs to switch suppliers.

Many MIM manufactures are procuring their raw materials through imports from countries such as Sweden, Germany, China, South Korea and Japan. Some companies do procure from domestic resources depending upon the availability. Raw material powders used in metal injection molding and 3D printing are similar; both processes require the powders to be bonded together with organic substance during mixing or kneading.

The end users of Metal Injection Molding (MIM) technology are predominantly from the automotive, healthcare, defence, and aerospace industries, with consumer applications also forming an important share

MIM has critical applications where the price is based on volume or economics of scale; customers pay premium, based on the accuracy and complexity of the precision product. Given MIM is a net shape manufacturing process, further machining required is minimal in most cases.

Hence, further machining for specific components is resorted to enable a finer finish. Customers of precision components (incl. MIM) pursue annual cost-down programs (price cuts, VA/VE, local sourcing), which squeeze supplier margins. Suppliers respond through lean manufacturing, automation, design collaboration, and scale efficiencies to stay competitive.

### 2.6 Global Competition Landscape (CY 2025)

The Global Metal Injection Molding market was estimated at USD 4.0 billion in CY 2025. Key contributors to the global revenue in order are China, USA, India, Europe, Taiwan, and Japan. With a dispersed base of producers catered in Mainland China, China is the world's largest producer of MIM. With a strong concentration on consumer electronics, Chinese manufacturers control about 53% (USD 2.11 billion) of the industry in CY 2025. The biggest smartphone OEMs, including Huawei, Lenovo, Apple, and Samsung, are based in the industrial zone of the Zhujiang Delta.

| Country | China | USA | India | Europe | Taiwan | Japan | Others | Total |
|---|---|---|---|---|---|---|---|---|
| **Revenue (USD Bn)** | 2.11 | 0.70 | 0.48 | 0.51 | 0.09 | 0.08 | 0.02 | 4.0 |
| **%** | **53%** | **18%** | **12%** | **13%** | **2%** | **2%** | **1%** | **100%** |

Setting up ceramic and metal injection molding plants involves a large investment in specialized equipment, for manufacture of molds and parts/components, inspection systems and material handling systems. For small-scale firms, this can be an entry barrier. Various automobile OEM clients follow demanding processes to onboard a vendor in the MIM business, which operate as entry obstacles for new companies. However, large volumes in automotive business justifies qualifying more than one vendor. In case of non-automotive customers initial tooling cost eliminates the possibility of qualifying more than one vendor in view of low to medium volume. The precision components manufacturing industry has barriers to entry. These barriers include the requirement for a higher initial investment in manufacturing molds, as well as the demand for complex execution and technical skills for the development of each new product for customers. In consumer electronics (e.g., smartphones), extremely high volumes allow OEMs to absorb high initial mold costs, making it viable to qualify multiple MIM vendors. This approach enhances supply security and cost competitiveness, similar to automotive, unlike aerospace/medical where volumes are too low to justify multi-sourcing.

Developing high-quality and commercially scalable precision products require significant capital investment and extensive research and development, creating substantial entry barriers for new players. Both Indian and global OEM customers have stringent selection procedures and product specifications for procurement from third party suppliers. This process is detailed and time consuming and typically takes 2-3 years to onboard a supplier as it involves supplier audits, testing, trial runs, periodic reviews and inspections of processes with regard to procurement, manufacturing, logistics and other capabilities and performance. The lead-time involved in the selection process serves as a potential barrier to entry for other manufacturers. Since the components we manufacture are typically used in assembly, these orders have a shorter lead time, are regular in nature and ensure visibility of revenues for us. Customers in the precision components industry generally pursue aggressive but systematic price reduction initiatives and objectives each year with their suppliers. Delay in capital expenditure cycles in certain international automotive markets such as Europe and Japan, coupled with evolving demand trends such as plateauing electric vehicle adoption and cost optimization measures by OEMs, may impact order volumes for high-precision components over the near term.

Other sectors where Chinese MIM has presence are automotive, power tools, communications, firearms, and medical devices. Currently, OEMs are shifting to global platforms and consolidating their supplier bases to capture greater total value content in individual programs.

Across the industries, a precision component is typically sourced from a single supplier because the cost of dedicated tooling and the burden of stringent validation make dual sourcing economically unattractive; this practice inherently limits the number of qualified sources and reinforces supplier exclusivity.

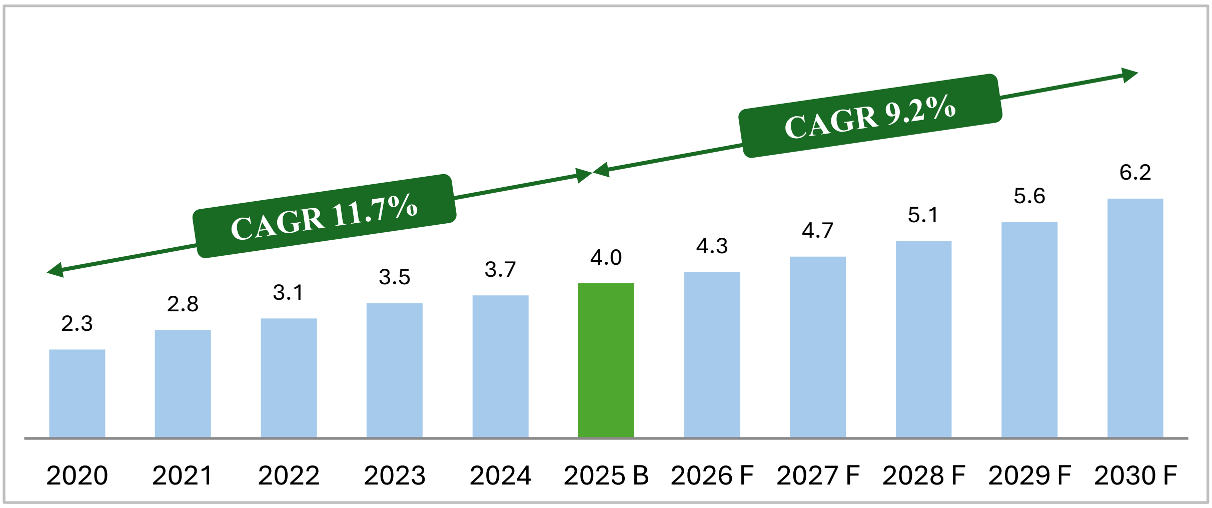
Top Ten global MIM manufacturers hold the market share of 37%. Indo MIM is the largest manufacturer globally of precision engineering components using MIM technology, with a market share of 6.8% in terms of revenue from MIM in CY 2025 and has held this position for the last six years. Indo MIM is well positioned to capitalize on the trend of OEMs shifting to global platforms and consolidating their supplier bases to capture greater total value content in individual programs. Other manufacturers include Jaingsu GIAN, China, CN innovation, China, Future Tech, GKN Powder Metallurgy, Germany, Schunk Germany, ARC Global, and Nippon Piston Rings. In India, NNF Tech, Vasantha Tool Crafts, and Orange Koi hold negligible market share. Any automotive supplier who supplies a component or system that ends up in an automobile must be certified, along with any automotive supplier who is contractually required by an automotive OEM to be certified.

MIM is primarily produced in Asia, with China, India, Japan, Taiwan, and Singapore leading the pack. MIM companies see 3D printing as an emerging technology that complements MIM, allowing for rapid prototyping and try-out without manufacturing a mold. Companies that have established themselves as reliable suppliers of components are the first port of call for customers who want to try out newly designed components.

International mid-size firms such as Kinetics, Phillips Medisize, Dynacast Portland, Porite, ATMIX, AMT, Jiangsu Tech, Waki Diecast, Uneec, AT&M, and Future Hi-Tech make up less than 30% of the worldwide MIM sales revenue.

## 2.7 Market Size Estimates and Forecasts for Metal Injection Molding Market

**Exhibit 13: Metal Injection Molding Global Forecast Year CY 2020–2030 (USD Billion)**




*Source: All figures are rounded. The base year is 2025 .B stands for Base Year; F stands for Forecast period*

*Frost & Sullivan*

Frost & Sullivan forecasted the market to grow at a CAGR of 9.2% between CY 2025 and CY 2030, to reach from USD 4.0 billion to USD 6.2 billion by 2030. Key drivers are growing demand in industry segments, such as automotive, aerospace, defence and medical. The market category for medical and Aerospace is anticipated to develop at the highest CAGR during the forecast period.

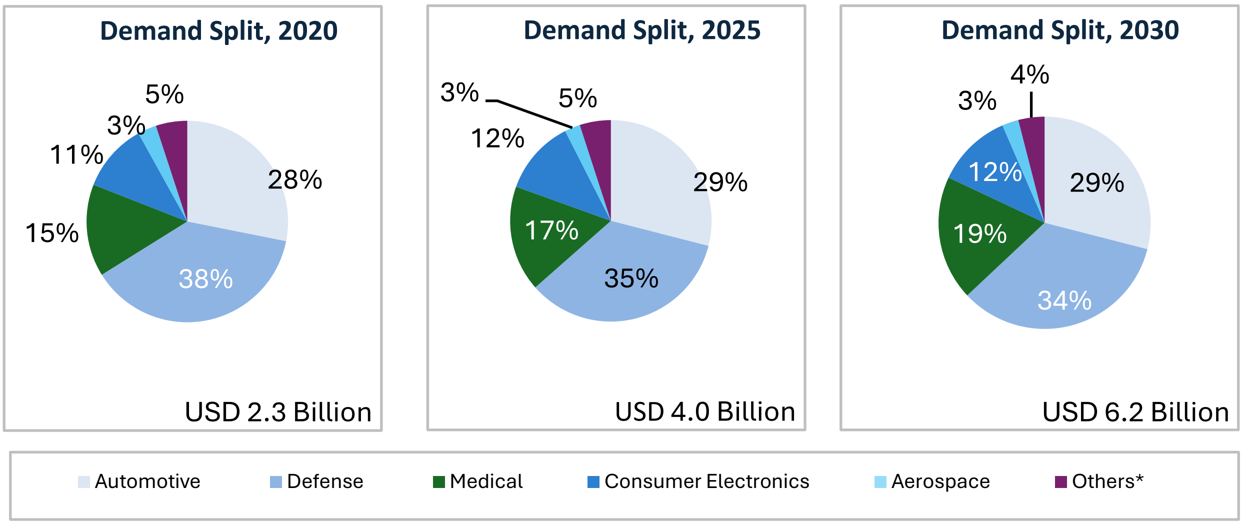
Consumer electronics is a key contributor of demand mainly driven by China; typical applications are phone casings (internal), camera parts, charging cables, laptop hinges, and mobile connectors.

Metal injection molded parts are now largely used by the automotive industry. Currently, MIM accounts for <1% of total automotive parts by count but makes up ~5–10% of high-strength precision small components in systems like engines, gearboxes, turbochargers, and locks. Engines, gearboxes, turbochargers, locking mechanisms, steering systems, and electrical systems all use high strength and high complexity elements. MIM rocker arms are produced by businesses for the automobile sector. For instance, Germany's Schunk GmbH manufactures metal injection molded rocker arms. The BMW engines employ these arms. It had a hollow design to reduce weight, which is challenging to do by other means.

Future expansion in the automotive industry is projected to be aided by the growing use of high strength components in engines and electronic systems. This technique produces powdered alloys that dramatically improve engine performance and lower vehicle fuel consumption. Lucrative opportunities for MIM technology are also being created by the rising need for lightweight and smaller automotive components.

### 2.8 Market Demand Split by Key Sector

**Exhibit 14: Demand Split by End-use Segment, USD Billion, CY 2020–2030**




**Others include industrial, plumbing, oil & gas, and power tools. All figures are rounded. the base year is CY 2025.*

*Source: Frost & Sullivan*

| Year/CAGR Growth | Medical Devices | Consumer Electronics | Aerospace | Defense | Automotive | Others* |
|---|---|---|---|---|---|---|
| CY 2020–2025 | 14.8% | 13.7% | 7.7 % | 9.6% | 12.4 % | 11.5% |
| CY 2025–2030 | 11.6 % | 8.2% | 9.2 % | 8.8% | 9.0 % | 5.4% |

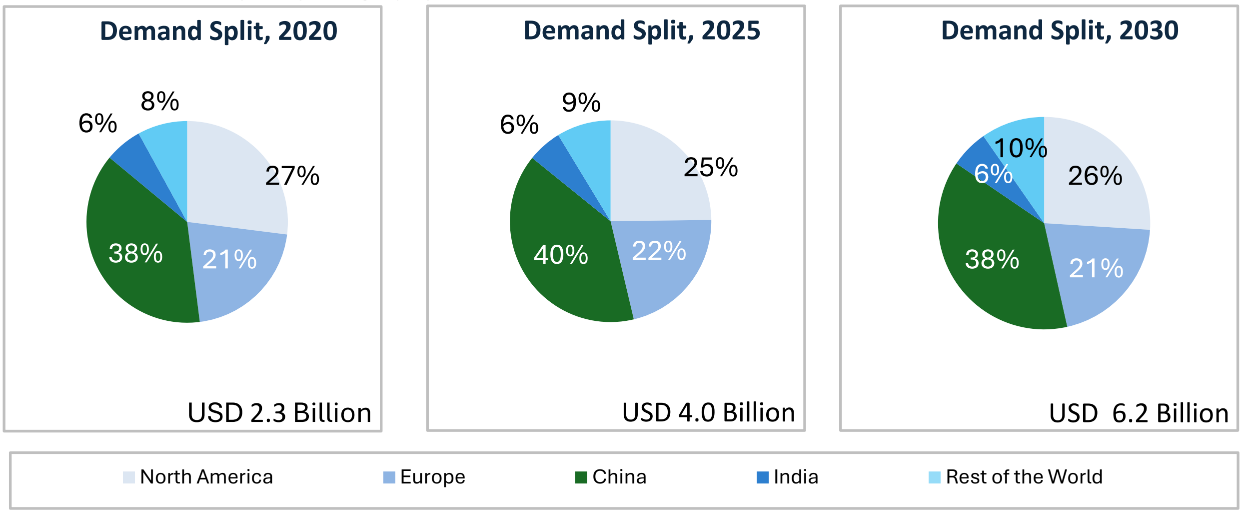
- **Aerospace:** MIM, which combines design flexibility and improved material qualities, is replacing smaller, conventional metal components in the aerospace sector. A long-term objective of aircraft design that can be accomplished with MIM is light weighting. Modern aircraft manufacturers strive to provide improved fuel efficiency and performance. MIM, a net-shape molding process, is replacing traditional metal components in aircraft manufacturing, combining design freedom with superior material properties, with over 49,000 aircraft expected by 2026.The global aerospace market size was estimated at USD 402.75 billion in 2025 and is expected to grow at the CAGR of 6.8% (CY 2025-2030). Frost & Sullivan estimates MIM demand from the aerospace to grow at the CAGR of 9.2% during CY 2025- 2030.
- **Medical Devices:** This segment has good long-term growth potential. The creation of implantable MIM products for uses like medicine delivery systems and joint replacement has advanced significantly. Injection molding is being used more and more to create translucent brackets with a much more discrete appearance. Tiny precision parts are typically composed of 316L stainless steel. The creation of implantable MIM products has advanced significantly for uses like medicine delivery systems and joint replacement.

MIM is used to manufacture orthodontic brackets, dental implants, surgical instruments, and endoscopic components. Its products are strong, biocompatible, and precise, enhancing the effectiveness of orthodontic procedures. MIM also produces surgical instruments like forceps, scissors, clamps, and needle holders, which improve surgical outcomes and patient recovery times. Additionally, MIM produces components for endoscopic devices like biopsy forceps and graspers. The most expensive component of the implanted infusion pump is its bottom plate, which is built of MIM-Ti6Al4V and combines various useful parts. The global medical devices market size was valued at USD 572.3 billion in 2025 and projected to grow at the CAGR of 14.8% during CY 2025-2030. Frost & Sullivan expects demand to grow at a steady pace during the forecast period at a CAGR of 11.6%.

- **Consumer Electronics:** Connectors, Interface shell, Camera Stand, Communication Cato & Notebook Shaft are key applications spanning across smartphone & laptop devices, which are created using metal injection molding. Multi-cavity molds can be used to make this small, intricate component in high / large volumes in a net-like shape. Metal injection molding's enormous volume capacity and low tolerances may be comparable to few other processes. Its ability to create complex, high-precision components at scale at a lower cost than traditional manufacturing methods attracts the consumer electronics manufacturers to use MIM products applications in areas like the wearables market, which includes smartwatches and fitness trackers, demands lightweight and durable components that can withstand daily wear and tear. MIM plays a critical role in the manufacturing of computer hardware components, such as heatsinks, cooling fans, and connectors. For example, heatsinks require high thermal conductivity to dissipate heat effectively, making materials like copper and aluminum suitable choices. The ongoing trend of miniaturization in consumer electronics has driven the demand for smaller, more intricate components. MIM is well-suited to meet this demand, as it can produce parts with complex geometries and minimal material waste. The global consumer electronics is valued at USD 870 billion during 2025 and is expected to grow at the CAGR of 7.5% (CY 2025-2030). Frost & Sullivan anticipates demand for MIM products to grow at a strong pace during the forecast period at a CAGR of 8.2%.
- **Automotive:** The automotive industry remains one of the largest end-use sectors for Metal Injection Molding (MIM), driven by increasing demand for lightweight, high-strength, and geometrically complex components used across engines, transmission systems, turbochargers, locking mechanisms, steering assemblies, sensors, and electronic systems. The rapid transition toward vehicle electrification is creating new opportunities for MIM adoption in battery systems, power electronics, thermal management, and precision connector applications. Global electric vehicle sales exceeded 17 million units in 2025, accounting for more than 20% of new vehicle sales worldwide, compared to approximately 18% in 2024 and less than 5% in 2020. The global electric vehicle market is expected to maintain strong double-digit growth through 2030, supported by tightening emission regulations, government incentives, and continued investments in charging infrastructure and battery technologies. The Global Automotive Industry Market Size was valued at USD 4,379.52 Billion in 2025 and is estimated to grow at the CAGR of 6-7% during CY 2025-30. Frost & Sullivan expects MIM demand from the automotive space to grow at the CAGR of 9.0% during CY 2025-2030.
- **Defense:** Metal Injection Molded components are being employed in high-performance applications like the production of gun triggers, where MIM performs better due to its fatigue qualities and lightweight. Its application is still restricted due to the high material costs. The market for MIM components in defense is predicted to expand quickly as these products are superior in quality and are more durable. The global defense market reached ~USD 600 billion during the year 2025 and is estimated to grow at the CAGR of 7% in CY 2025-2030. Increasing the FDI limit in defense sector, make in India initiatives would allow for the introduction of cutting-edge technology and manufacture of arms in India. With the skills of foreign businesses, local firms would be able to improve their capabilities and achieve self-sufficiency. Many affluent countries have seen growth in their defense sectors by allowing 100% FDI. Frost & Sullivan expects this segment to grow rapidly at a CAGR of 8.8% during the forecast period CY 2025-2030.

### 2.9 Market Demand Split by Geography

**Exhibit 15: Demand Split by Geography, USD Billion, CY 2020-2030**




Source: Frost & Sullivan; All figures are rounded. The base year is CY 2025

MIM demand is expected to be influenced by aerospace, defence, and medical sectors in China, North America, Europe, and key Asian markets, as well as consumer electronics in these regions.

The global Metal Injection Molding market is projected to reach USD 6.2 billion by CY 2030 from an estimated USD 4 billion in CY 2025, at a CAGR of 9.2% Percent during CY 2025 and 2030.

| Year/CAGR Growth | North America | Europe | China | India | Rest of World |
|---|---|---|---|---|---|
| CY 2020–2025 | 9.8 % | 12.2 % | 12.6% | 9.8% | 13.6% |
| CY 2025–2030 | 10.2% | 8.1 % | 8.3 % | 10.3% | 11.6% |

North American market for Metal Injection Molding is estimated to increase from USD 992 million in 2025 and reach USD 1,612 million by 2030, at a CAGR of 10.2% during the forecast period of 2025 through 2030.
Europe market for Metal Injection Molding is estimated to increase from USD 860 million in 2025 to reach USD 1,271 million by 2030, at a CAGR of 8.1% during the forecast period of 2025 through 2030.
The China market for Metal Injection Molding is estimated to increase from USD 1,580 million in 2025 to USD 2,356 million by 2030 at a CAGR of 8.3% during the forecast period of 2025 through 2030. Rest of World (RoW), comprising Japan, South Korea, and Taiwan is on a higher growth trajectory.

### 2.10 Global Sectorial Growth Opportunities

#### 2.10.1 Key Growth Opportunities in Metal Injection Molding in Key Sectors

**Exhibit 16a: Key Growth Opportunities**

| Industry Sector | Drivers |
|---|---|
| Increasing number of automotive applications | • MIM components are also employed in applications such as housings, cams for motorized seating, lock caps and lock shafts, and bonnet lock parts. Potentially, MIM components might transform numerous conventionally built single engine components into an integrated assembly, resulting in fewer moving components and significant financial savings. MIM enables lightweighting and material flexibility (steel, aluminum, specialty alloys), supporting the EV transition by integrating mechanical + electronic functions in high-volume, precision components. |

| | |
|---|---|
| Ideal solution for advanced defence applications | • "Safe and Arm" Rotor: The military "safe and arm" rotor is used in an explosive device for a US Department of Defence application<br>• Pistol Upswept Grip Safety Part: Pistol safety part used in the .45-calibre pistol made by Colt Manufacturing Company, LLC., USA, performs several functions such as blocking the trigger from firing, shielding the hammer from injuring the shooter's hand when the pistol cycles, and interacting with the shooter's palm for comfort. This complex part is manufactured from MIM 17-4 PH stainless steel to a density of 7.6g cm3. |
| Provides quality and accuracy for medical devices | • High-quality, accurate parts that are biocompatible and sterilizable are required by the medical sector. MIM components are utilized in the medical industry to manufacture small, sophisticated, and precise components like as surgical tools, orthodontic brackets, dental implants, and drug delivery systems. MIM parts are favoured in the medical field because of their excellent precision, biocompatibility, and sterilizability.<br>• MIM parts are also used for biopsy devices like biopsy forceps, which are frequently manufactured in stainless steel using MIM technology, due to the complex form and durability required for this equipment, as well as a good surface finishing being the part directly in contact with patients |
| Focused growth of consumer electronics.<br>` | • Growing demand for miniaturization of electronic devices, such as smartphones, laptops, and wearable.<br>• China's metal injection molding market is on pace to grow at ~8.3% CAGR (CY 25–30), significantly outpacing the global industry average of 9.2% primarily supported by its expanding electronics industry. It is also noted that India's MIM growth rate is estimated to grow at the CAGR of 10.3% during the forecast period (2025-2030) |
| Gaining importance in aerospace industry | • Increasing demand for lightweight and fuel-efficient components in the aerospace sector drives the demand.<br>• MIM technology is extensively used in the aerospace sector, particularly when producing small and medium-sized parts. This process creates turbine vanes for gas turbine motors, which enhances the engine performance and reduces fuel usage. Parts for satellites are also produced using MIM technology, with intricate antenna structures which are crucial for a satellite's ability to interact with both other satellites and ground stations. |

*Source: Frost & Sullivan*

### 2.10.2 Growth Opportunity: Key advantage wrt material composition, CY 2025

**Exhibit 16b: Key Growth Opportunities**

| Context and Definition | Call to Action |
|---|---|
| Unlike powder metallurgy, components with complex features, holes, logo, and radii can be easily built into the mold and injected out using MIM technology, which makes the technology very attractive to the automotive and aerospace industries. | • The aerospace industry uses various material compositions for aircraft body parts and components. Some of these material compositions are not compatible with MIM. For now, the industry is only able to use MIM in manufacturing small engine components, seatbelt components, valve holders, airline flap screws, and rocket burner systems.<br>• Because of high material cost, MIM of titanium components is currently limited to high-performance applications or luxury consumer products where titanium adds exclusivity and marketability.<br>• As titanium powder prices fall, the demand for MIM components is expected to grow dramatically, as will the adoption of the metal in the aerospace, defence, military and firearm industries. |

*Source: Frost & Sullivan*

### 2.10.3 Success Factors: MIM Industry, CY 2025

**Exhibit 16c: Key Success Factors of MIM Industry**

1. **Design & Tooling Capabilities** – The Metal Injection Molding (MIM) industry's ability to produce complex, high-precision parts relies heavily on design and tooling capabilities. Effective design and tooling enable manufacturers to create intricate geometries, optimize production efficiency, and ensure part quality.

2. **Metallurgical & Polymer science Know-how** – The ability to produce high-quality, complex MIM parts relies heavily on metallurgical and polymer science expertise — spanning material selection, powder characterization, feedstock preparation, and process control to ensure optimal performance. Equally critical is the availability of skilled human capital, with expertise in feedstock formulation, part design, tooling, and sintering processes. This combination of metallurgical know-how and specialized talent enables manufacturers to deliver precision, consistency, and innovation at scale.

3. **Intellectual Property** – Ability to innovate and stay competitive relies heavily on intellectual property (IP) capabilities. Effective IP management enables companies to protect their innovations, maintain market exclusivity, and drive growth.

4. **Resilient Supply Chain** – Established long-term relationships facilitating better pricing and consistent supply of high-quality metal powders; ability to deliver high-quality parts relies heavily on a resilient supply chain. A well-managed supply chain ensures timely delivery, reduces risks, and improves overall competitiveness.

5. **Quality Control Mechanism** – Establishing stringent quality standards & protocols, especially required in industries such as medical, aerospace. Capability to deliver high-quality parts relies heavily on robust quality control mechanisms. Effective quality control ensures consistency, reduces defects, and improves customer satisfaction.

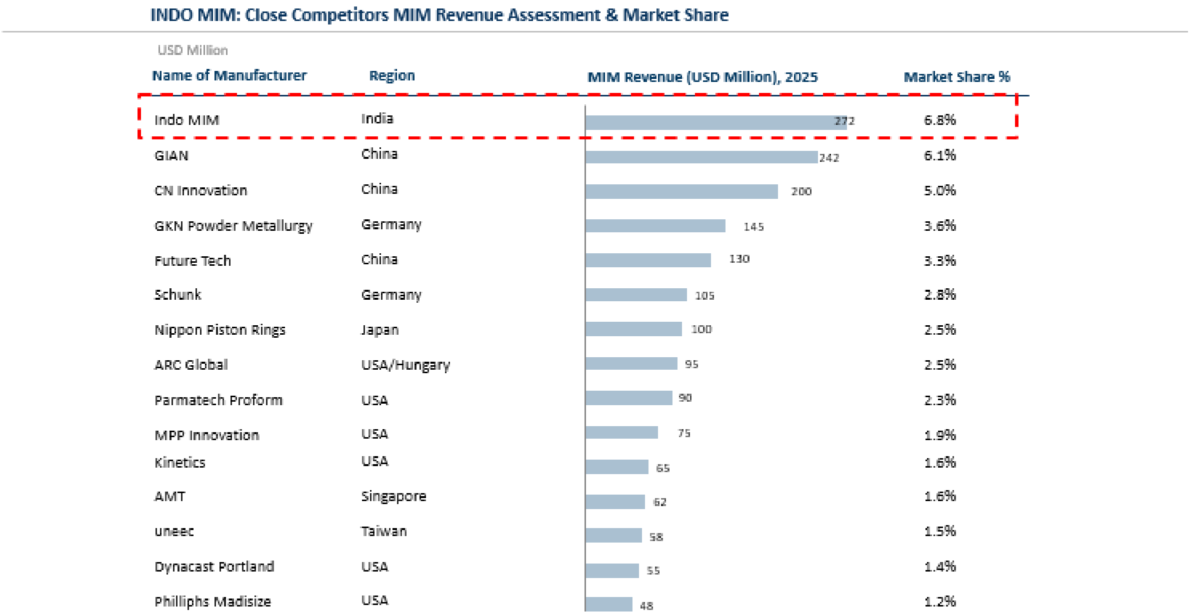
6. **Global Presence / Establishing capacity closer to the customer base (near/dual shoring) -** Facility to deliver high-quality parts globally relies on a strategic presence and proximity to customer bases. Establishing capacity closer to customers through nearshoring or dual shoring enables companies to improve responsiveness, reduce lead times, and enhance customer satisfaction.

### 2.10.4 Threats and Challenges – Metal Injection Moulding (MIM)

| Challenge Area | Key Threats & Constraints | Industry Implication |
|---|---|---|
| **Cost Structure & Economics** | High tooling and part development costs; feedstock price volatility; energy-intensive debinding and sintering | Limits viability for low-volume parts; margin pressure during energy and raw material upcycles |
| **Raw Material & Feedstock Availability** | Concentrated supply of MIM-grade powders; strict requirements on particle size, shape, and purity; limited recycled content usage | Supply chain rigidity; long qualification cycles; higher dependency on few global suppliers |
| **Process Complexity & Yield Risk** | Multi-stage processing increases defect probability; shrinkage and distortion control challenges; limited recyclability of rejected parts | Lower yields raise unit costs; tight process control required to maintain consistency |
| **Scale & Application Constraints** | Economically suited only for small, high-volume components; size and geometry limitations; long ramp-up for new parts | Constrains addressable market relative to casting or machining routes |
| **Substitution & Technology Competition** | Competition from precision CNC machining, metal additive manufacturing, fine blanking, and die casting | Erodes MIM's cost and flexibility advantage in low-to-medium volume applications |
| **OEM Qualification & Adoption Barriers** | Lengthy qualification timelines; limited design familiarity among OEM engineers; conservative procurement practices | Slower commercialization and delayed capacity utilization |
| **ESG & Regulatory Pressures** | High carbon intensity of sintering; emissions from binder removal; increasing demand for traceability and carbon disclosure | Rising compliance costs; pressure to shift toward low-carbon energy and cleaner binder systems |
| **Talent & Capability Gaps** | Shortage of experienced MIM engineers; steep learning curve for new entrants; limited regional clusters | Slows scaling and innovation; increases execution risk for greenfield projects |

## 2.11 Global MIM Competitive Analysis:

**Exhibit 17a: INDO-MIM: Close Competitors Global MIM Revenue Assessment & Market Share: CY 2025**




*Source: Frost & Sullivan Competition Analysis*

* For *Indo MIM, MIM revenue for FY 2026 is INR 2454.31 Cr. Which is converted into USD using exchange rate of 1 USD = 90.12*
*For Jiangsu Gian MIM revenue is converted into USD using the exchange rate of 1 USD = 6.78 RMB*

**Exhibit 17b: Global MIM Competitive Landscape**

The below table cover top 15 MIM Manufacturers who holds 40-45% of global market demand. Indo MIM holds the highest market share of 6.8%

| Company | Country | MIM Revenue (USD Mn) | Industries Served | Product Portfolio |
|---|---|---|---|---|
| INDO-MIM | India | 272 (CY 25) | Aerospace, Automotive, Medical, Defence, Consumer Goods | Metal injection molding, Precision machining, Additive Manufacturing |
| Jiangsu GIAN (Public listed) | China | 242 (CY 25) | Electronics, Medical Devices, Tools, Vehicle | Metal injection molding, CNC & Automation, Surface Treatment |
| CN Innovation | China | 200 (CY 25) | Vehicles, Medical Devices, Electronics | Metal injection molding, Metal Processing, Surface Treatment |

| | | | | |
|---|---|---|---|---|
| GKN Powder Metallurgy | Germany | 145 (CY 25) | Automotive, Aerospace, Medical | Conventional Powder Metallurgy, Metal Injection Molding |
| Future Tech | China | 130 (CY 25) | Automotive, Aerospace, Medical | Metal Injection Molding, Ceramic Injection Molding, Bulk Metal Glass |
| Schunk | Germany | 105 (CY 25) | Aerospace, Automotive, Defence, Medical, Electronics, consumer Goods | Metal injection molding |
| Nippon Piston Rings | Japan | 100 (CY 25) | Automotive, Marine | Metal injection molding |
| ARC Global | US/Hungary | 95 (CY 25) | Automotive, Aerospace, Medical | Metal injection molding |
| Parmatech Proform | USA | 90 (CY 25) | Healthcare Aerospace Telecommunications Défense Industrial | Metal injection molding, FASTMIM, HDMIM, 3DPM |
| MPP Innovation | USA | 75 (CY 25) | Orthodontics, Medical, Industrial, Consumer Applications, Aerospace and Defence | Powder Metallurgy, Metal Injection Molding, Soft Magnetics, Aluminum |
| Kinetics | USA | 65 (CY 25) | Automotive, Industrial Equipment, Power Hand Tools, Pumps, Surgical Instruments | Metal Injection Molding |
| AMT | Singapore | 62 (CY 25) | Medical, Automotive, Industrial, Electronics | Metal Injection Molding, Medical Device Manufacturer, Precision, 3D |
| Uneec | Taiwan | 58 (CY 25) | Medical, Automotive, Industrial, Electronics | Metal Injection Molding |

| | | | | |
|---|---|---|---|---|
| Dynacast Portland | USA | 55 (CY 25) | Medical, Automotive, Industrial, Electronics | Metal Injection Molding |
| Philliphs Madisize | USA | 48 (CY 25) | Medical, Automotive, Consumer, Defense Electronics | Metal Injection Molding |

* For *Indo MIM, MIM revenue for FY 2026 is INR 2454.31 Cr. Which is converted into USD using exchange rate of 1 USD = 90.12*
*For Jiangsu Gian MIM revenue is converted into USD using the exchange rate of 1 USD = 6.78 RMB*

## 2.12 Brief Profile of Major MIM Producers

### 2.12.1 INDO-MIM, India

| **Ownership** | **Privately Held** | **Company Overview** |
|---|---|---|
| **Founded** | 1996 | • Indo-MIM has expanded its manufacturing capabilities over the years and as of March 31, 2026, Indo-MIM has the world's largest installed capacity for MIM products. Indo MIM is a preferred supplier for certain OEM customers.<br>• India has several manufacturing plants, including main plants in Hosakote, Bangalore, Doddaballapura, and Tirupati. In the United States, Indo-MIM Inc. in San Antonio, Texas, Triax Industries in Chandler, Arizona, and PDV Medtech in the USA, specialize in directional solidification casting and CNC machining. CMG Technologies in the UK offers MIM and 3D printing services for various sectors.<br>• Hoskote MIM Plant: MIM of small volume components predominantly for defence<br>• Doddaballapur Plant: Which houses MIM, ceramics, precision machining and stainless-steel powder manufacturing medium-to-large volume components predominantly for automotive, medical and aerospace industries; this plant also houses its powder manufacturing unit.<br>• Tirupathi Investment Casting: Manufactures complex parts using investment casting, predominantly for automotive sector<br>• USA San Antonio: Manufacture of MIM parts (medium/large volumes) for defence and medical segments.<br>• Triax Industries was acquired by INDO-MIM Pvt Ltd in 2020. 100% Wholly Owned Subsidiary of Indo-MIM specializing in vacuum casting and serving the Land based Gas Turbine industry and Aero space Industry.<br>• Acquired CMG technologies to expand its UK operation.<br>• Woodbridge, Suffolk Ipswich UK – 100% WOS of Indo-MIM specializing in manufacture of components using MIM and 3 D printing.<br>• INDO-MIM's consolidated equipment across plants includes 200 molding machines, 45 big-size batch furnaces, and 5 continuous furnaces, 3 of which are the world's largest continuous furnaces used in the MIM Industry.<br>• Founded in 1996, the company has won 24 awards from the Metal Powder Industries Federation (MPIF). INDO-MIM has achieved a leadership position in the field of MIM, providing |
| **Headquarters** | Bangalore, Hoskote, India | |
| **No of Employees** | 4,424 | |
| **MIM Revenue (FY 2025-26)** | USD 272 Million | |
| **CEO** | Krishna Chivukula Jr | |
| **Product/ Technology** | Technology and material developer | |
| **Markets Served** | North America, Europe, and India | |

| | | |
|---|---|---|
| | | precision-engineered products to customers in more than 52 countries in the Americas, Europe, and Asia.<br>• The company has more than 4,400 employees and served several customers across the world<br>• The facilities are ISO 9001:2015, IATF 16949: 2016, ISO 13485: 2016, ISO 14001:2015, AS 9100: 2016, and ISO 45001: 2018 certified.<br>• Apart from MIM, the company also provides investment casting, 3D printing (binder jetting) ceramics injection molding, precision machining, and processing; Indo-MIM has forayed into metal 3D printing technology and as an early adopter of this technology, Indo-MIM is one of the first players to deploy 'Desktop Metal Production System' which is the world's first metal 3D printing system for mass production.<br>• Indo MIM's commitment to innovation and efficiency is evident from their ability to produce 45 to 50 new tools per month, which has led them to be among the fastest in the MIM industry towards new product introductions.<br>• Faster turnaround of product development process without manufacturing of molds may become a catalyst for MIM business, and customers can quickly protype complex parts without investing on mold and then having to switch it over to MIM for large-scale manufacturing.<br>• The Company serves it products and solution to various sectors like Aerospace, Automotive, Consumer Electronics, Industrial applications which include hardware industry, fasteners, plumbing and oil and gas, along with medical device sector<br>• The strategic location of Indo MIM's manufacturing facilities in India provides cost and logistical advantages. |

* For *Indo MIM, MIM revenue for FY 2026 is INR 2454.31 Cr. Which is converted into USD using exchange rate of 1 USD = 90.12*

### 2.12.2 Jiangsu Gian Technology Co, Ltd, China

| **Ownership** | **Public Listed** | **Company Overview** |
|---|---|---|
| **Founded** | 2004 | • The top 25 shareholders own 45.78% of the company. Mingxi Wang, the chairman of the company owns 19.4% of the share, Yi Chao Huang- the board of directors holds 4.9% share followed by Changzhou Chuangyan Investment Consulting Co., Ltd (4.06%), Golden Eagle Asset Management Co. Ltd (2.17%), Jun Wen Wu (2.03%), Shanghai V-Investment Co., Ltd (1.61%), China Merchants Fund Management (1.45%), Shanghai Jiahong Private Fund Management Co., Ltd.(1.29%), Crassets Investment (1.28%), Tianshan Quantitative (Beijing) Capital Management Co., Ltd. (1.25%) and others with less than 1% share of the company. The general public-- including retail investors -- own 47% stake in the company<br>• GIAN (Gathering, Innovation, Ahead, Non-top) has two factory sites in China: Changzhou with an area of 65,000 square meters and Dongguan with an area of 20,000 square meters. Both sites possess |
| **Headquarters** | Changzhou, Jiangsu | |
| **No of Employees** | 5,001–10,000 | |
| **MIM Revenue (CY 2025)** | USD 242 Million | |
| **Chairman of the Board & GM** | Mingxi Wang | |

| | | |
|---|---|---|
| **Product/ Technology**<br><br>**Markets Served** | Metal Injection Molding<br><br>China, Japan, Germany, India | advanced continual sintering furnaces and post-processing equipment.<br>• GIAN made heavy investment in furnaces; it now has both Japanese Shimazu vacuum furnace and German continual sintering furnaces.<br>• GIAN had achieved ISO14001:2015 environmental management system certification, ISO9001:2015 quality management system certification, QC080000:2017 Hazardous substance process management system certification, IATF16949:2016 automotive quality management system certification, ISO13485:2016 medical device quality management system certification, ISO45001:2018 occupational health and safety management system certification, ISO27001:2013 information security management system certification, and AEO certification.<br>• Jiangsu Gian MIM, a metal injection molding company in China, specializes in research and development of ferrous-based and stainless steel structural MIM parts, functional components, and appearance components. With a strong technical team led by experienced experts and foreign technical support, they offer high precision, complex shapes, and good mechanical properties to meet customer needs.<br>• GianMIM operates in the manufacturing industry of metal injection molding, it designs, produces, and sells a variety of MIM parts in electronic devices, medical device, tools and vehicles. |
| **MIM Machine Capability** | | 150 sets of FANUC CNC machines |

*For Jiangsu Gian MIM revenue is converted into USD using the exchange rate of 1 USD = 6.78 RMB*

### 2.12.3 CN Innovation - Zoltrix Material International Limited: China

| Ownership | Private | Company Overview: |
|---|---|---|
| **Founded** | 1990 | • Zoltrix's Metal Injection Molding (MIM) history began in 1990 when Chung Nam Watch Company Limited implemented MIM technology for watch components. By 1992, small-scale production began, and in 1995, production moved to a new site in Guangzhou, China. The facility was expanded in 1998, and the company's components remain an important part of its business.<br>• Zoltrix is today a part of CN Innovations (CNI), a business of the Chung Nam Group of companies that was established in 2006 with investment from the Chung Nam Watch Company Limited<br>• The Company is headquartered in Hong Kong and the company's main production facilities are located in Guangzhou<br>• The main materials processed by Zoltrix are 316L and 17-4PH stainless steels, which the company states, are produced in equal proportion. Parts from these two material types enjoy the highest production volumes, ranging from hundreds of pieces to several million pieces per day. In addition to stainless steels, low alloys steels, tool steels, tungsten and ceramics are also produced. |
| **Headquarters** | Hong Kong | |
| **No of Employees** | 1,000 - 2,000 | |
| **MIM Revenue (CY 2025)** | USD 200 Million | |
| **CEO** | Matt Jennings | |
| **Product/ Technology** | Metal/Plastic Injection molding | |
| **Markets** | Global Presence | |
| **MIM Machine Capability** | | 250 injection molding machines<br>9 continuous sintering furnaces |

### 2.12.4 GKN Powder Metallurgy, Germany

| Ownership | Public Listed | Company Overview |
|---|---|---|
| Founded | 1960 | • GKN is the world's 4th largest MIM parts supplier with a global market share of 3.6%<br>• With over 30 global locations and more than 6,000 employees worldwide. The GKN stand featured conventional Powder Metallurgy, powder forged parts, bearings and filters as well as Metal Injection Molded parts.<br>• The company, which is traditionally closely linked to the automotive market, sees Hannover as a chance to establish contact with non-automotive purchasing agents and consequently diversify into other markets.<br>• GKN's Metal Injection Molding plant, GKN Sinter Metals GmbH, Bad Langensalza, Germany, is one of the three leading MIM operations in Europe.<br>• GKN manufactures several hundred tons of MIM parts per year for the automotive industry and other industrial customers worldwide<br>• GKN offers Alloy steels, stainless steels, and heat-resistant alloys in its MIM applications. |
| Headquarters | Germany | |
| No of Employees | 5,001–10,000 | |
| MIM Revenue (CY 2025) | USD 145 Million | |
| CEO | Jean-Marc Dubois | |
| Product/ Technology | Metal Injection Molding | |
| Markets Serviced | Global Presence | |
| MIM Machine Capability | | Binder Removal/Furnace, Feedstock Equipment, Molds and Tooling, Molding Machines |

### 2.12.5 Future Tech, China

| Ownership | Public Listed | Company Overview |
|---|---|---|
| Founded | 1999 | • Future Tech offers complex, high strength Metal (MIM) and Ceramic (CIM) Injection Molded components.<br>• With over 35 patents in MIM technology, the company has quickly become one of the largest MIM suppliers in the world. Product is produced in Shanghai, China, with warehousing and distribution options in the US.<br>• Future High Tech has ramped up to 3 facilities scattering Shanghai and Shenzhen with total employees around 2,900 and R&D engineers account by 10%<br><br>**R&D Activities:**<br>• The company is focusing on research activities for improving MIM process capability, exploring new materials in MIM, and in-depth exploration of MIM and post-operation. |
| Headquarters | China | |
| No of Employees | 2,900 | |
| MIM Revenue (CY 2025) | USD 130 Million | |
| Chairman of the Board & GM | Tony Foo | |
| Product/ Technology | Metal Injection Molding | |
| MIM Machine Capability | | 400 Injection Machine, 78 Vacuum Sintering Furnace, 8 continuous sintering furnaces<br>12 sets of feeding equipment's, 76 sets of degreasing furnace, 20 sets of CMM |

### 2.12.6 Schunk Group (Schunk Sinter metalltechnik GmbH), Germany

| Ownership | Private | Company Overview |
|---|---|---|
| **Founded** | 1913 | • As a division of the Schunk Group, Sinter Metals has over 90 years of experience in powdered metallurgy.<br>• Schunk Sinter Metals is a professional technology and development partner when it comes to the manufacture of sintered metal parts with axial press technology and metal injection molding (MIM).<br>• Schunk Sinter Metals has three production facilities in Germany and Mexico and has high focus in the automobile industry all over the world.<br>• Schunk Sinter Metals is thus far the only manufacturer in the world to offer two material 2C (Schunk Sintermetalltechnik GmbH, manufactured the 2C-pin is the first serial part produced by the Metal Injection Molding of two different materials, in this case 316L stainless steel and the cobalt-base alloy Stellite 12) component MIM for serial production.<br>• With the two-component technique, Schunk Sinter Metals has been able to scale new heights in MIM technology. Materials with different properties can be combined and fit perfectly together, like two pieces of a puzzle. The two parts are produced in a single processing step.<br>• The Company supplies its MIM products to industries like Aerospace, Automotive and mobility |
| **Headquarters** | Giessen, Hessen | |
| **No of Employees** | 9,100 (consolidated) | |
| **MIM Revenue (CY 2025)** | USD 105 Million | |
| **CEO** | Dr. Arno Roth | |
| **Product/ Technology** | MIM Automotive Focus: Combustion engines<br>• Electronic systems<br>• Battery and charging systems | |
| **Markets Served** | Europe | |
| **MIM Machine Capability** | | Three production facilities in **Germany (Giessen and Thale)** and **Mexico**, offering robust capacity for sintered structural parts and MIM components. |

### 2.12.7 ARC Group worldwide Inc: USA

| Ownership | Private | Company Overview: |
|---|---|---|
| **Founded** | 1987 | • ARCMIN, a division of ARC Group Worldwide, is one of the leading companies in the MIM industry. The company offers services in metal, plastic, magnesium injection molding, medical clean room molding, metal stamping, and 3D printing in metal and plastic.<br>• FloMet, LLC is part of the ARC Group located in Deland Florida and specializes in MIM-Medical devices<br>• ARC Group provides a holistic set of precision manufacturing solutions, from design to prototyping through full-run production. These solutions include metal injection molding, plastic injection molding, clean room injection molding; it also possesses an in-house tooling.<br>• ARC Group Worldwide, Inc., is a global advanced manufacturer offering a full suite of products and services, with specific expertise in MIM, the company also offers complementary technologies, such as (i) traditional and clean room plastic injection molding; and (ii) advanced rapid and conformal tooling.<br>• Through its diverse product offerings, its offers customers a holistic prototyping and full-run production solution for precision metal and plastic fabrication. The Company caters to key end users like |
| **Headquarters** | De Land, FL | |
| **No of Employees** | 201–500 | |
| **MIM Revenue (CY 2025)** | USD 95 Million | |
| **CEO** | Jedidiah Rust | |
| **Product/ Technology** | Metal/Plastic Injection Molding | |

| | | |
|---|---|---|
| **Markets Served** | Global presence | Aerospace, Automotive, Defence, Other Industries and Medical Manufacturing Devices. |
| **MIM Machine Capability** | | Precision grinders - 20, 3 & 4-Axis CNC mills - 20, Precision 5-Axis CNC mills -2<br>92 electric and hydraulic molding machines ranging in size from 17 ton to 500 ton<br>21 large scale vacuum sintering furnaces with both Moly and Graphite hot zones as well as 9 atmospheric retort furnaces |

### 2.12.8 Parmatech, USA

| **Ownership** | **Public Listed** | **Company Overview** |
|---|---|---|
| **Founded** | 1973 | • Parmatech, an ATW Company, is a leading supplier of custom manufactured Metal Injection Molding (MIM) components since 1973.<br>• Parmatech strives to offer the best solution package to customers which includes identifying prototyping needs, rapid prototyping, alloy development, and metrology assistance. Engineered Metal Solutions provided by Parmatech, an ATW Company. |
| **Headquarters** | USA | |
| **No of Employees** | ~ 1,000 | |
| **MIM Revenue (CY 2025)** | USD 90 Million | |
| **Chairman of the Board & GM** | Peter Frost | |
| **Product/ Technology** | Metal Injection Molding | |
| **MIM Plant Capability** | | 15 Molding machines at its Petaluma plant, Nissei and Arburg injection molding machines, 7 in the Parmatech Proform plant in East Providence, Rhode Island plant are from Wittmann Battenfeld |

### 2.12.9 Nippon Piston Rings, Japan

| **Ownership** | **Public Listed** | **Company Overview** |
|---|---|---|
| **Founded** | 1934 | • Nippon Piston Rings is said to have contributed to the development of motorization on a global scale through the provision of high-performance, high-quality Powder Metallurgy piston rings, valve seat inserts, camshafts, and other parts primarily for use in internal combustion engines.<br>• In addition to press-and-sinter Powder Metallurgy, Nippon Piston Ring also uses Metal Injection Molding (MIM) to manufacture a wide range of precision components such as automotive valve seat inserts, rocker arm parts, turbocharger components, injector parts, gears, and other high-strength, complex small parts for engines and transmissions.<br>• *Metamold* .is the registered trademark for Nippon Piston Ring's metal injection molding products |
| **Headquarters** | Sagami, Yamato City | |
| **No of Employees** | 800 – 1,000 | |
| **MIM Revenue (CY 2025)** | USD 100 Million | |
| **Chairman of the Board & GM** | Teruo Takahashi | |

| | | |
|---|---|---|
| **Product/ Technology** | Metal Injection Molding | • In the metalmold business the company develops MIM products which are used in wide range applications of automobile, aerospace, industrial and medical devices |
| **Markets Serviced** | North America, China, Indonesia, Thailand and India | |

### 2.12.10 MPP Innovation

| **Ownership** | **Privately Held** | **Company Overview** |
|---|---|---|
| **Founded** | 1948 | • US-based MPP focuses on the development of custom-engineered powdered metallurgy solutions and MIM services.<br>• Its metal injection molding plant was shifted to Noblesville, Indiana which has a built-up area of 45,000 Sq.m.; its technical capabilities also include MPP's addictive manufacturing.<br>• The company is an expert in designing and manufacturing aluminium powdered metallurgy components. The company also provides ferrous, stainless steel, and soft magnetic components.<br>• In February 2021, MPP acquired Net Shape Technologies (which was involved in the manufacturing of powder metal products and MIM components) to improve its MIM portfolio.<br>• In July 2022, the company won the Award of Distinction from Metal Powder Industries Federation (MPIF) for a high-strength camshaft bearing cap, which was manufactured using powdered metallurgy aluminium powder.<br>• The company has 9 facilities across the US and China and focuses on providing custom-engineered complex structural parts, high-strength aluminium parts, gears, sprockets, and components with improved physical and mechanical properties. |
| **Headquarters** | Noblesville, Indiana, US | |
| **No of Employees** | 1,000–5,000 | |
| **MIM Revenue (CY 2025)** | USD 75 Million | |
| **CEO** | Paul Johnson | |
| **Product/ Technology** | MIM technology and material developer | |
| **Markets Served** | Global | |

Other manufacturers in India include **Vasantha Tool Crafts Pvt. Ltd.** An ISO 9001:2015 certified company, established in the year 1989 in Hyderabad, Telangana state of India, has successfully designed & manufactured over 2000 high precision, high cavitation plastic injection molds and support major multi nationals across the globe. It has art manufacturing facility for Metal Injection Molding within house Metallurgical Lab. The Company invested in various debinding technologies such as thermal debinding, catalytic debinding, and solvent debinding. **NNF Tech Pvt. Ltd**. is a global supplier of Metal Injection Molded (MIM) components. Since, its inception in 2013. The Company's manufacturing facility located in Bangalore, India with design, engineering & manufacturing under one roof. It has presence in more than 10 countries and provide one stop solutions to its customers.

**Orange Koi** has its metal injection molding facility in Visakhapatnam, India. It manufactures high-performance small precise parts for the medical, automotive, aerospace, industrial, and defence industries using metal injection molding technique and Additive Manufacturing technologies.

### 2.12.12 Key Mergers & Acquisitions in MIM (CY 2015–2025)

| Year | Acquirer / Buyer | Target Company | Region | Strategic Rationale |
|---|---|---|---|---|
| **2025** | Indo-MIM (India) | Phoenix DeVentures II Inc. (USA) | North America | Boost presence in medical segment |
| **2023** | Indo-MIM (India) | CMG Technologies (UK) | Europe | Expand European presence; MIM + AM capabilities |
| **2020** | Indo-MIM (India) | Triax Industries LLC (USA) | North America | Add casting & machining expertise; aerospace capability |
| **2023** | Cadence (USA) | ARC Group (FL location) | North America | Broaden regional footprint |
| **2023** | Philpott Solutions Group | Castino | — | Expand material/service offerings |
| **2022** | Performance Engineered Products | Molding Corp. of America (MCA) | — | Boost tooling/casting capacity |
| **2021** | Metal Powder Products Inc. | Proform Powdered Metals | — | Enhance powder material offerings |

## 2.13 KPIs Major MIM Producers

The below Financial KPI's are basis reporting on consolidated basis and individual reported revenues is not reported, under competition landscape we have reported their MIM revenue.

**Exhibit 18a: Financial Metrics of the MIM producers: CY 2025**

| Name of the company | MIM Revenue (USD Mn) | EBITDA Margin (%) | PAT (%) | ROE (%) | Years of Existence | Number of Employees | Geography Serviced |
|---|---|---|---|---|---|---|---|
| **Indo MIM** | 272 | 25.5% | 12.7% | 21.3% | 30 | 4424 | North America, Europe, and India |
| **Jiangsu GIAN** | 242 | 14.7% | 10% | 3.1% | 22 | 5,001-10,000 | China, Japan, |
| **GKN Powder Metallurgy** | 145 | 9.1% | NA | NA | 66 | 5001-10,000 | Global Presence |
| **Nippon Piston Rings** | 100 | NA | NA | NA | 92 | 800-1000 | North America, China, Indonesia, Thailand and India |
| **MPP Innovation** | 75 | NA | NA | NA | 78 | 1000-5000 | Global Presence |
| **Uneec** | 58 | NA | NA | NA | 49 | 2000-3000 | Global Presence |

*Note: Financial values are as of CY 2025*
***** For *Indo MIM, MIM revenue for FY 2026 is INR 2454.31 Cr. Which is converted into USD using exchange rate of 1 USD = 90.12*
*For Jiangsu Gian MIM revenue is converted into USD using the exchange rate of 1 USD = 6.78 RMB*
*Source: Annual Report of the companies, Pitchbook*

**Exhibit 18b: Financial Benchmarking of Competitors CY (2023-2025)**

| Figures in USD Mn | CY | Indo MIM | Jiangsu GIAN | GKN Powder Metallurgy | Nippon Piston Rings | Uneec | MPP Innovation |
|---|---|---|---|---|---|---|---|
| Country | | India | China | Germany | Japan | Taiwan | USA |
| Revenue from Operation | 2023 | 319 | 324 | 1,099.4 | 432.3 | 207.4 | 129.4 |
| | 2024 | 369 | 318 | 1,155.2 | 450.5 | 195.1 | NA |
| | 2025 | 465 | 429 | 1400 | 472 | NA | NA |
| Revenue from Operations Growth (%) | 2023 | 6.6% | -12.4% | 3.5% | -4.4% | -5.3% | 2.9% |
| | 2024 | 16.0% | -1.7% | 5.1% | 4.2% | -6.0% | NA |
| | 2025 | 25.9% | 34.8% | 21.2% | 4.8% | NA | NA |
| EBITDA | 2023 | 82 | 68 | 100.8 | NA | 22.8 | NA |
| | 2024 | 103 | 56 | 93.45 | NA | NA | NA |
| | 2025 | 119 | 63 | 128 | NA | NA | NA |
| EBITDA Margin | 2023 | 25.9% | 21.0% | 9.2% | NA | 11.0% | NA |
| | 2024 | 28.0% | 17.7% | 8.1% | NA | NA | NA |
| | 2025 | 25.5% | 14.7% | 9.1% | NA | NA | NA |
| PAT | 2023 | 31 | 23 | NA | NA | 8.1 | NA |
| | 2024 | 47 | 19 | NA | NA | NA | NA |
| | 2025 | 59 | 10 | NA | NA | NA | NA |
| PAT Margin | 2023 | 9.9% | 7.2% | NA | NA | 3.9% | NA |
| | 2024 | 12.7% | 6.0% | NA | NA | NA | NA |
| | 2025 | 12.7% | 2.3% | NA | NA | NA | NA |
| Return on Equity | 2023 | 14.0% | 7.9% | NA | NA | NA | NA |
| | 2024 | 19.9% | 6.1% | NA | NA | NA | NA |
| | 2025 | 21.3% | 3.1% | NA | NA | NA | NA |
| Return on Capital Employed | 2023 | 19.6% | 13.4% | NA | NA | NA | NA |
| | 2024 | 23.5% | 11.8% | NA | NA | NA | NA |
| | 2025 | 26.6% | 12.0% | NA | NA | NA | NA |
| Fixed Asset Turnover Ratio | 2023 | 1.3 | 1.2 | NA | NA | NA | NA |
| | 2024 | 1.2 | 1.1 | NA | NA | NA | NA |
| | 2025 | 1.3 | 1.5 | NA | NA | NA | NA |
| Debt to Total Net Worth (times) | 2023 | 0.5 | 0.1 | NA | NA | NA | NA |
| | 2024 | 0.6 | 0.0 | NA | NA | NA | NA |
| | 2025 | 0.4 | 0.1 | NA | NA | NA | NA |
| Net Debt to EBITDA | 2023 | 1.2 | -1.0 | NA | NA | NA | NA |
| | 2024 | 1.2 | -1.9 | NA | NA | NA | NA |
| | 2025 | 0.7 | -2.0 | NA | NA | NA | NA |

** For Indo MIM the Financial under CY 2023 is their performance during FY 2023-24 and so on*
*Exchange rate 1 USD = INR 90.12*
*For Jiangsu Gian values are converted into USD using the exchange rate of 1 USD = 6.78 RMB*
*Source: Annual reports and Pitchbook*

*The KPI numbers of Indo MIM is derived using the following formulas:*

- *Revenue from Operations = Revenue from operations as appearing in the Restated Financials*
- *Revenue from Operations Growth = (Revenue from Operations in the current year / Revenue from Operations in the previous year) – 1*
- *EBITDA = Profit/(Loss) for the year + Finance cost + Depreciation and amortization costs + Tax expenses + Exceptional costs/ - Exceptional Income - Other income*
- *EBITDA Margin = EBITDA / Revenue from operations*
- *PAT = Profit/ (Loss) for the year as appearing in the Restated Financials*
- *PAT Margin = Net Profit after tax (PAT) / Revenue from operations*
- *Return on Equity = Net Profits after taxes (PAT) / Average Total Equity over the current period and previous period*
- *Return on Capital Employed = Earnings before interest and taxes and exceptional items / Capital Employed; Earnings before interest and taxes and exceptional items = Profit / (Loss) for the year + Total tax expense + Finance costs + Exceptional items. Capital employed = Tangible Net worth (after adjusting for Other Comprehensive Income in Equity)+ Total debt + Deferred Tax*
- *Fixed Asset Turnover = Revenue from operation / Average Fixed assets over the current period and previous period; Fixed Assets = Gross Block of property, plant & equipment*
- *Net Debt to EBITDA = Net debt divided / EBITDA; Net Debt =Total Borrowings (Current + Non Current) - Cash and cash equivalents*
- *Debt to Net worth Times = Total debt / Total Equity. Total Debt = Current Borrowings + Non-Current*

*The KPI numbers of Jiangsu Gian is derived using the following formulas:*

- *Revenue from Operations = Total operating income in the Consolidated Income Statement*
- *Revenue from Operations Growth = (Revenue from Operations in the current year/Revenue from Operations in the previous year)- 1*
- *EBITDA = Net profit from continuing operation (Consolidated Income Statement) + Financial Expenses (Consolidated Income Statement) - Other Income (Other Income + Investment Income + Non-operating income -Non-operating expenses; Consolidated Income Statement) + Taxes (Taxes and surcharges + Income tax expense; Consolidated Income Statement) + Exceptional costs (Gains from change in fair value + Credit impairment losses + Asset impairment losses + Gains from asset disposal; Consolidated Income Statement) + Depreciation (Depreciation of fixed assets, oil & gases assets etc + Depreciation of right of use assets + Amortization of intangible assets; Supplementary Information for Cashflow Statement)*
- *EBITDA Margin = EBITDA/ Revenue from operations*
- *PAT = Net Profit from continuing operations in the Consolidated Income Statement*
- *PAT Margin = PAT/Revenue from operations*
- *Return on Equity = PAT /Average Total Equity over the current period and previous period (Total equity attributable to the parent company; Consolidated Balance Sheet)*
- *Return on Capital Employed = Earnings before interest and taxes and exceptional items (Net profit from continuing operation (Consolidated Income Statement) + Financial Expenses (Consolidated Income Statement) + Taxes (Taxes and surcharges plus Income tax expense; Consolidated Income Statement) + Exceptional costs (Gains from change in fair value plus Credit impairment losses plus Asset impairment losses plus Gains from asset disposal; Consolidated Income Statement))/ Capital Employed (Total Equity + Short term loans + Long term loans + Deferred tax liability - Deferred tax assets; Consolidated Balance Sheet)*
- *Debt to Net worth times = Total Debt (Short term loans + long-term loans; Consolidated Balance Sheet)/ Total Equity (Total equity attributable to the parent company; Consolidated Balance Sheet)*
- *Fixed Asset Turnover = Revenue from operation /Average Fixed assets over the current period and previous period (Gross Fixed Assets)*
- *Net Debt/ EBITDA = Net debt (Short term loans (Consolidated Balance Sheet) + long-term loan (Consolidated Balance Sheet) - Cash and cash equivalents at the end of the period (Consolidated Cashflow Statement)) / EBITDA*

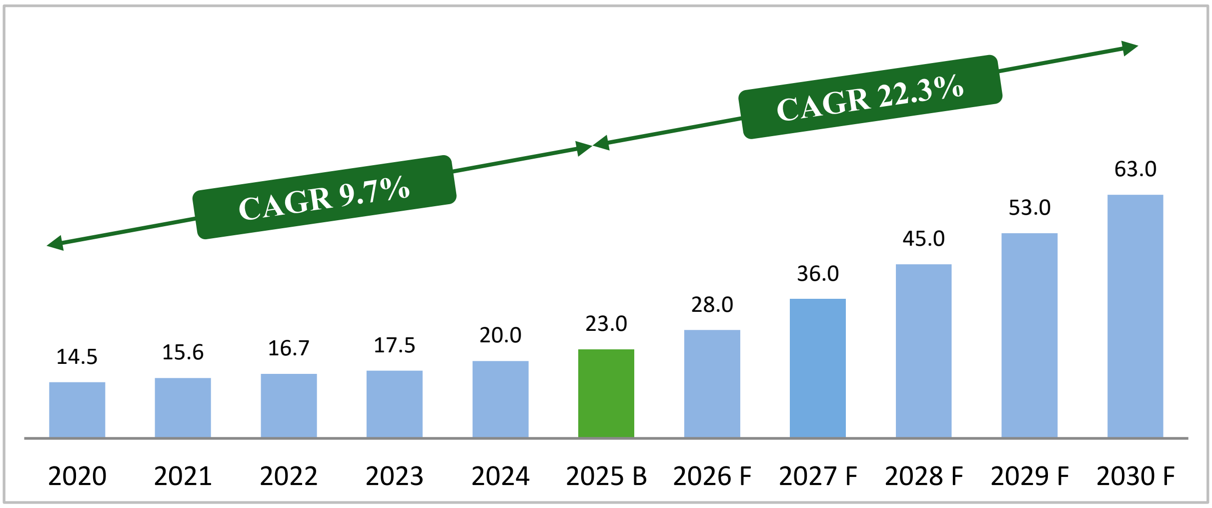
## 3. Introduction to 3D Printing

### 3.1 Overview of 3D Printing

There have been 3D printers for almost 30 years. Between 2013 and 2015, the use of 3D printing technology increased due to the expiration of several patents in the fields of stereo lithography, digital light processing, and selective laser sintering, as well as the introduction of cheaper, faster, more user-friendly printers.

The market is anticipated to expand at 22.3% CAGR from 2025 to 2030, rising from ~ USD 23 billion in 2025 to USD 63 billion in 2029.

**Exhibit 18: 3D Printing Global Forecast Year CY 2020–2030 (USD Billion)**




3D printing has many applications, with market value contributing to applications such as functional parts, tooling, and prototyping. The MIM industry uses prototyping applications and can serve as a key driver for industrial 3D printing. It is further categorized into material types such as metals, polymers, and ceramics. The 3D printing material type is classified into Plastic Powders (20%), Plastic Filaments (38%), Photopolymers (13%) and Metals (29%).

Based on the material split 3D Metal Printing market size was estimated at USD 6.7 billion (29%) in 2025. Industrial printers and Desktop printers are key metal printer type. It is observed that an Industrial printer alone accounts for almost USD 5.8 billion (87%). Industrial printers use a variety of metal 3D printing technologies, including powder bed fusion, directed energy deposition, and binder jetting, and they can produce large, complex parts with high levels of detail and accuracy.

MIM uses metal 3D printing with technologies like Laser Powder Bed Fusion and Binder-Jet technology. When MIM is combined with metal 3D printing, an additive manufacturing technology, designs can be tested and iterated with ease. Metal 3D printing is an advanced additive manufacturing technology that uses powdered metals to build a three-dimensional component by applying evenly distributed layers.

Re-filing of patents and technology acquisition were started when participants started to use and understand the technology better. New features were later added as a result. Design, software, printer, and dimensional precision advancements increased the technology's dependability and broadened its application beyond the industrial industry to include universities and labs. Due to its quicker turnaround, a variety of businesses are embracing the growth of 3D printing.

The new rapid prototyping is based on injection molding with low-cost mold plates that are 3D printed from long-lasting polymer-based materials. Compared to injection molding with typical metal inserts, the technology enables the production of microfluidics in standard thermoplastic materials at a lower cost and with a shorter lead time. Currently, up to 100 parts can be molded from a single 3D printed insert without degradation. With the 3D printing machine used in this work, the smallest feasible design feature is approximately 100 m. The cast pieces are shiny and have a smooth surface finish suitable for a variety of microfluidic applications.

MIM manufacturing requires specialized tooling to create components in medium- to high-volumes. MIM components often weigh less than 100 g, with intricate geometries, and stringent standards and specifications.

Early adopters of the technology were aerospace, automotive, and healthcare. The level of adoption of 3D printing varies among application sectors due to differences in applications and material restrictions. Geographically, 3D printing is expanding in Europe and North America

Metal 3D printing also known as additive manufacturing allows for the fabrication of complex metal parts with precision. Typically, traditional manufacturing methods often involve subtractive processes, such as milling, drilling, or reaming, which can result in material waste and limitations on design complexity. Metal 3D printing eliminates many of these constraints, enabling the production of intricate, lightweight, and highly customized metal components. The following are the types of metal 3D printing technologies:

- Binder Jet 3D Printing: It is an additive manufacturing technique that involves the deposition of metal powders layer by layer, followed by the application of a liquid binding agent. This process is repeated until the desired object is fully formed. Once the print is complete, the bound metal powder structure is removed from the printer and subjected to a secondary process, such as sintering, to bond the metal particles and achieve the required strength. This technique allows for rapid fabrication as it eliminates the time-consuming process of melting metal powders, making it ideal for mass production. It is utilized to produce lightweight metal components, functional prototypes, tooling, and end-use parts.

- Laser Powder Bed Fusion: It is a metal 3D printing process wherein a high-powered laser selectively melts and fuses metal powders together layer by layer. The laser is precisely controlled by a computer-based system, ensuring accuracy and intricate detailing. This technique allows for the fabrication of complex parts, consolidating multiple components into a single piece, thus reducing assembly time, and improving overall performance. It is utilized for producing components like turbine blades, medical implants, customized automotive parts, and high-performance tools.

**Exhibit 19: Factors Driving the Growth of 3D Printing**

| | |
|---|---|
| **Customized & Rapid Production Turnaround** | Metal 3D printing reduces inventory holding stock by providing customized, short-run production parts in a timely manner. This technology is particularly beneficial for small production lots, which most metal manufacturing facilities struggle to handle efficiently. For example, the English racing team in Oregon created a one-off prototype for a replacement metal pulley gear in just 5 hours, overcoming the need for mold, tooling, and long lead times. |
| **Cost Effective** | Metal 3D printers range from office-friendly desktop sizes to large machines, with prices from less than USD 100,000 and an average price of more than USD 800,000. Key market participants, such as Desktop Metal, 3D Systems, and ExOne offer affordable metal 3D printing solutions for engineering and designing complex metal parts that are safe and easy to use, without the need for skilled or dedicated operators. |
| **Minimal Waste** | Conventional processes create excessive waste that can be eliminated by using metal 3D printers in which only the required material is melted to build the component. The minimal labour-intensive process produces only 1% to 3% scrap, with the provision to reuse the scrap, making 3D printing a cost-effective environment friendly technique |
| **New Shapes & Structures** | 3D metal printing enables new applications, such as offering options for rigorous customization for hip joint implants in healthcare, conformal structures for the aerospace industry, using nano twinned copper for conductive part printing, and sound or acoustic waves as a source for printing final parts. |
| **New Business Models** | 3D metal printing meets individual market needs and can offer enterprises machines that reduce costs, facilitate shift from product push to product pull models, and enable fulfilment of requirements at point of use. |
| **Superior Time to Market** | Besides new opportunities and business models, metal 3DP enables faster production through digital iterations that eliminate various steps at the beginning and the end of the supply chain, accelerating launch of products. |

Source: Frost & Sullivan

### 3.2 Metal 3D Printing Steps Involved in Conventional Manufacturing vs. Additive Manufacturing

Production using conventional techniques often requires initial investment. Further any change in the design will require additional investment in molds. In 3D printing one can make the required shape in low volumes at a comparatively lower cost.

**Exhibit 20a: 3D Printing Process vs. Other Conventional Processes**

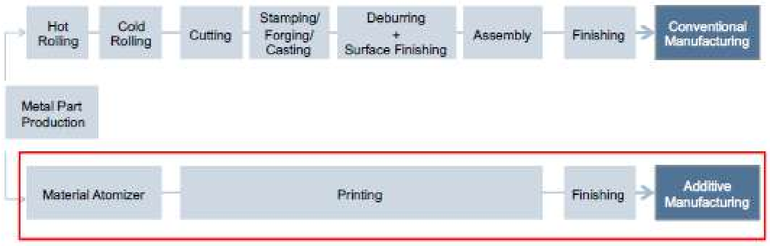
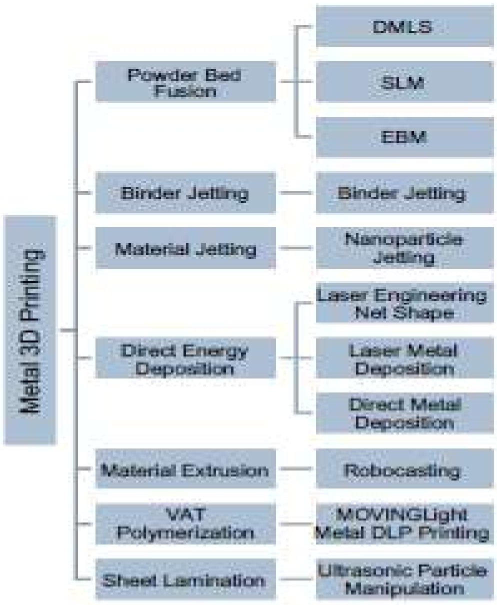



**Exhibit 20b: 3D Printing, a Brief Overview**




*Source: Frost & Sullivan*

**Additive manufacturing,** also known as 3D printing, is commonly known for its capability to produce a fully complete structure, without the need for assembly or a great deal of surface finish. This toolless manufacturing approach has given the manufacturing industry design flexibility, shortened the time to market, and reduced use of resources, enabling an economical approach to production. The main applications of additive manufacturing are rapid prototyping, tooling, part production, repair of existing parts and producing spare parts using plastic, metal, ceramic, and composite materials.

3D printing of plastics has had a significant impact on industries, inducing greater research into and market adoption of metal 3D printing. The two important parameters identified in the metal additive manufacturing research have been the type of material being used and the energy source for processing.

Metal materials may be powders or wires or liquids that can be processed using electron beam, plasma arc, or laser. The metal additive manufacturing processes can be segmented into wire- and powder-based technologies, with recent innovations in liquid-based techniques on the rise due to materials that render higher resolution in the final part.

### 3.3 Major Impact of 3D Printing Technology

- **Decentralize production:** By reducing the cost and complexity of production, 3D printing will force companies to pursue alternate ways to differentiate their products. It will also help companies enhance their aftermarket services by facilitating easy on-demand manufacturing of replacement parts. As manufacturing is moving closer to the consumers, the consumer sector is rapidly adopting advanced manufacturing technologies such as MIM, driven by the need for miniaturization, lightweighting, and high-precision components

- **Drive product customization:** Being a tool less procedure, 3D printing technology enables manufacturer's unrivalled freedom to customize products to customers' unique needs. As a result, supply chains will be more flexible and able to respond to market changes more quickly. Design, production, and distribution may eventually be combined into a single supply chain function with increased client involvement throughout the full design and production process.

- **Simplify processes and accelerate time to market:** Using 3D printing network could even be a way to scale production without adding more of their own equipment. The complexity of global supply chains will be minimized coupled with lower production costs, lower lead times, and reduced inventory costs.

- **Boost resource efficiency:** 3D printing is an environmentally friendly, cost- and energy-conscious manufacturing method. It almost eliminates the waste, reduces the potential of excess production and stockpiles, and reduces the carbon footprint. This improves 'Just-in-Time' production.

- **Rationalize inventory and logistics:** If 'on demand' production becomes the norm, the need to ship physical things across borders and continents will decline. This will have a significant effect on warehousing, logistics, and may even be able to get around tariffs given the decreased number of SKUs needed for production.

### 3.4 Growth in 3D Printing application by sector:

**Automotive**

Rapid prototyping is crucial before actual product manufacturing and implementation in another sector of the economy. Supply chains can benefit greatly from 3D printing, which opens up a wide range of production applications. Companies are able to bring additive manufacturing in-house to help procedures on the factory floor as the technology becomes more practicable and inexpensive. High quality, functional 3D prints that can substitute for final items and give (mass) customization options and high performance are now possible thanks to new, robust materials.

**Medical**

The potential benefit of 3D printing innovations, also known as additive manufacturing, to enhance the treatment of certain medical diseases is drawing attention of the health care industry. A dentist may scan a fractured tooth to manufacture a crown that perfectly fits the patient's mouth, just as a radiologist can make an accurate reproduction of a patient's spine to aid in planning a surgery. In both situations, the medical professionals can employ 3D printing to create things that precisely match the anatomy of a patient.

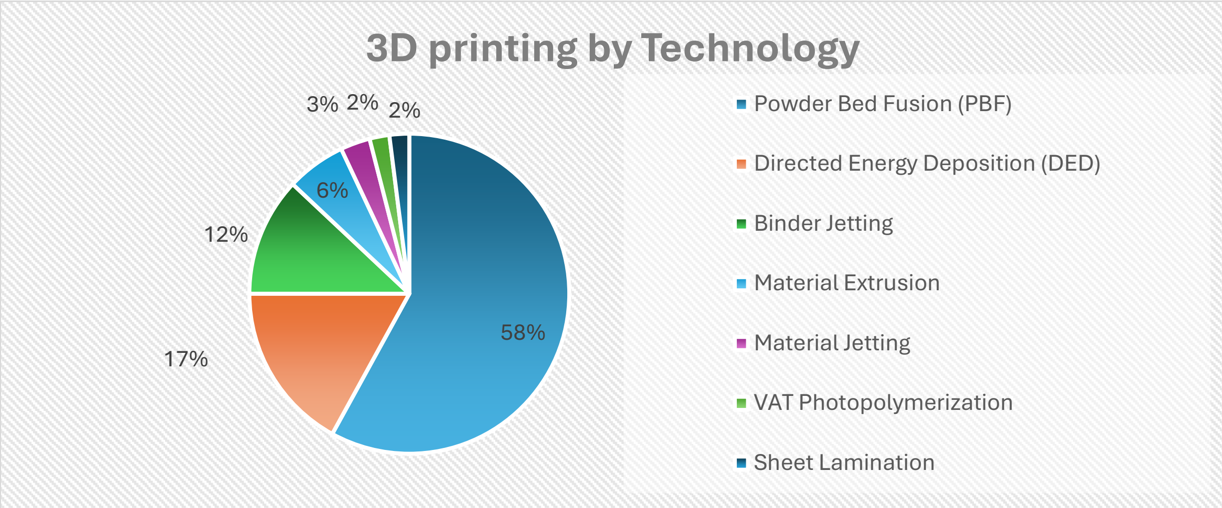
Furthermore, the technology has made it possible to create customized orthopaedic implants like hips and knees as well as bespoke prosthetic limbs, cranial implants, and dental restorations like crowns. However, its ability to alter the production of medical products, particularly high-risk ones like implants, could have an impact on patient safety, posing new difficulties for FDA regulation.

**Aerospace**

The aerospace and aviation industries were among the first to use 3D printing, but the adoption rates are low. The aerospace sector demands components with critical nature and complex systems. Therefore, businesses collaborated with research organizations to create complex and effective methods to increase the usage of 3D printing technology. Global firms like Boeing, Dassault Aviation, Airbus, and others are already making effective use of this technology in their manufacturing and research. Major application of 3D printing in Aerospace industry includes Prototyping Aerospace Tooling With 3D Printing, 3D Printed Masking Jigs, 3D Printed End-Use Aerospace Parts with Electroplating, and 3D Printed Wind Tunnel Test Parts.

### 3.5 Metal 3D Printing: Technologies

**Exhibit 21: Current and Emerging Application Areas in 3D Printing**




| Technology | Production Stage | Acquisition Cost | Attractiveness |
|---|---|---|---|
| Powder Bed Fusion (PBF) | Low- to medium-volume production | USD 300K–1.5 Mn | PBF is the dominant metal additive manufacturing technology, accounting for nearly 60% of the installed industrial metal AM base. Its high precision, excellent surface finish and broad material compatibility make it the preferred choice for aerospace, medical, automotive and high-value industrial applications. |
| Binder Jetting | Medium- to high-volume production | USD 250K–1.0 Mn | Binder Jetting is one of the fastest-growing metal AM technologies due to its high build speed, scalability and lower cost per part. The process selectively deposits a liquid binder onto a metal powder bed, followed by debinding and sintering, making it suitable for serial production in automotive, industrial and consumer applications. |
| Material Jetting | Prototype and precision manufacturing | USD 350K–800K | Material Jetting offers exceptional dimensional accuracy and surface finish, making it suitable for precision tooling, prototypes and specialized applications. However, high equipment costs and limited metal material availability have restricted its adoption in industrial metal manufacturing. |

| | | | |
|---|---|---|---|
| Material Extrusion | Prototyping and low-volume production | USD 80K–300K | Metal Material Extrusion uses metal-filled filaments followed by debinding and sintering to produce components. Lower equipment costs and operational simplicity make it attractive for prototyping and tooling, although density and mechanical property limitations continue to restrict widespread industrial adoption. |
| Directed Energy Deposition (DED) | Repair, refurbishment and large-part manufacturing | USD 600K–2.0 Mn | DED is primarily used for repairing high-value components, adding features to existing parts and manufacturing large metal structures. Although capital intensive, its ability to process large components and perform near-net-shape manufacturing is driving adoption across aerospace, defense and energy industries. |
| VAT Photopolymerization | Indirect metal part manufacturing | USD 80K–500K | VAT Photopolymerization is primarily used to produce high-precision patterns, molds and tooling for investment casting rather than finished metal parts. Its role in direct metal additive manufacturing remains limited due to material constraints. |
| Sheet Lamination | Niche and hybrid manufacturing | USD 150K–800K | Sheet Lamination, including Ultrasonic Additive Manufacturing (UAM), enables multi-material components with minimal thermal distortion. While offering advantages in speed and material flexibility, its limited geometric complexity and structural performance have confined adoption to niche aerospace, electronics and research applications. |

*Source: Frost & Sullivan*

### 3.6 Outcomes of 3D Printing

**Exhibit 22: Key Outcomes of 3D Printing Technology**

| | |
|---|---|
| **Product Diversity** | This capability allows a manufacturer to have a broader product range and a wider diversity of product offerings. On-demand manufacturing technology is more flexible than conventional technologies. It allows designing products and printing items that could not be made previously. This is exemplified in the design of the Adidas midsole, by Carbon's CLIP technology which enables a high-performance, personalized geometry that is fundamentally unachievable with traditional technology. 3D printing enables the printing of only high-quality, manufacturing-grade products with complete design freedom. |
| **Mass Customization** | 3D printing enables customization of shoes, football helmets, ear buds, and medical devices. With the advent of Internet of Things (IoT), organizations are exploring ways to leverage technologies and change business strategies to meet the high demand for customization. Organizations are not focusing on having thousands of product lines for customers but on ensuring they have a product designed for every customer. 3D printers are being integrated with connectivity tools and IoT solutions that deliver high levels of customization and scalability, based on demand. |
| **On-demand Inventory/ Warehouse in the Cloud** | 3D printer systems are built from the ground up and can enable the 3D printing of a product instead of producing large quantities of products and storing them as inventory. Printers are being integrated with the business process, and data is stored at a single point in the printer. With IoT and sensors, installed data is shared throughout the |

| | |
|---|---|
| | organization so that anyone can initiate operations of part printing and gain clear visibility of activities. |

*Source: Frost & Sullivan*

**Exhibit 23: Global 3D Printing Competitive Landscape**

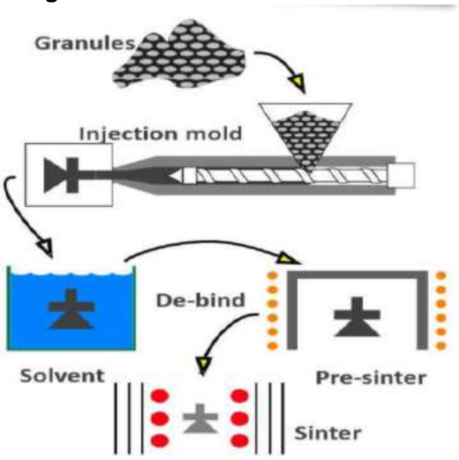
The below table cover top 5 3D printing Manufacturers who holds 40-45% of global market demand.

| Company | Consolidated Revenue CY 2025 (USD Mn) | Country | Key Insights |
|---|---|---|---|
| Stratasys, Ltd. (SSYS) | 551.1 | USA | Stratasys, founded in 1989, is a leading technology company offering solutions for various industries, including aerospace, healthcare, and consumer products. The company produces desktop 3D printers and large-scale production systems for digital manufacturing, based in Minnesota and Israel. |
| Proto Labs Inc. (PRLB) | 533.1 | USA | Proto Labs, established in 1999, specializes in automated solutions for manufacturing plastic and metal parts. They have expanded to offer industrial-grade 3D printing services, enabling developers and engineers to integrate prototypes into production, including injection molding and sheet metal fabrication. |
| 3D Systems Corp. (DDD) | 386.9 | USA | Chuck Hall invented stereolithography in 1983, creating the first 3D-printed art. In 1986, he founded 3D Systems, the world's first 3D printing company. The company has since developed new technologies, including selective laser sintering, multi-jet printing, and plastic jet printing. 3D Systems offers a range of 3D printers. |
| Materialise NV (MTLS) | 304.0 | Belgium | Materialise, a Belgian company, has been offering 3D printing solutions and software since 1990. It supports industries like healthcare, automotive, aerospace, and art and design. The company's early 3D printing activities included anatomical models in dental and hearing aid products, eyewear, and automobile products. |
| Desktop Metal Inc. (DM) | 160.0 | USA | Desktop Metal, established in 2015, is a Massachusetts-based company that designs and manufactures 3D printing systems, focusing on performance-driven materials and technologies. Serving industries like automotive, consumer goods, machine design, and manufacturing tooling, it offers speed and reliability. |

### 3.7 Overview of Ceramic Injection Molding

The market for ceramic injection molding is anticipated to grow at the CAGR of 6.8% from USD 450 million in 2025 to USD 626 million by 2030. The inherent advantages that CIM offers allows engineers and designers to focus on quality and precision, working closely with customer specifications and a closely monitored process that meets this requirement. The low cost and complex designing capabilities of CIM technology offer higher economies of scale and cut manufacturing time by eliminating elaborate machining and finishing.

**Exhibit 24a: Ceramic Injection Molding: Production Process**




Source: Frost and Sullivan

Fine Ceramic powder is mixed with a polymer binder. This mixture is granulated to form ‘feedstock’. Feedstock is heated to form viscous slurry and injection molded to form ‘green’ part. Part of the binders is removed through solvent de-binding to get ‘brown’ part. The brown part is densified through sintering to get a ‘finished’ part.

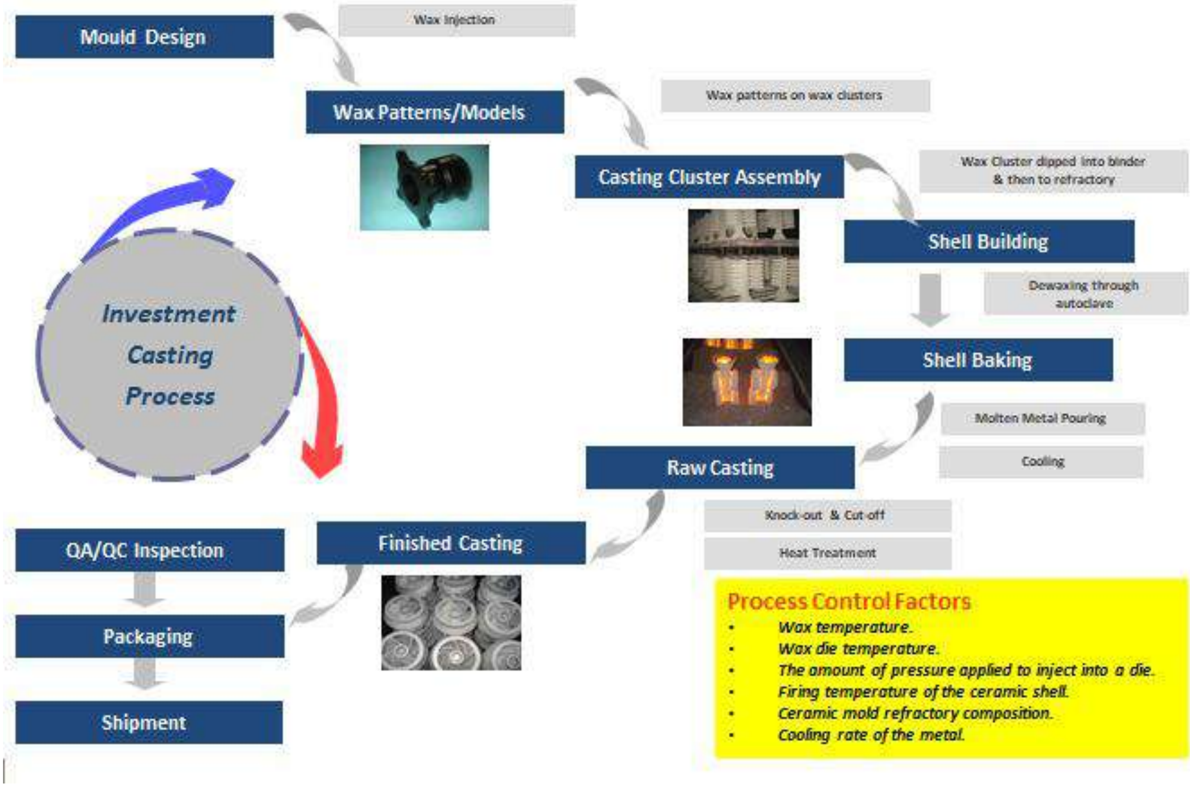
In a six sigma-controlled environment, ceramic injection molding is an innovative new process. With increased productivity, cheaper manufacturing costs, and better product performance, the CIM method allows production engineers and product designers more flexibility when using ceramics as an alternative material. When it comes to replacing metal and plastic parts that aren't working properly, CIM is another excellent choice.

The ceramic injection molding process gives production engineers and product designers versatility in the use of ceramics as an alternative material. Ceramic injection molding is alternate to plastic and metal components if wear resistance is a key requirement. The inherent advantages of the ceramic injection molding process place focus on quality and precision, working closely with customer specifications and a closely monitored process that meets these requirements. The low cost and complex designing capabilities of ceramic injection molding technology offers higher economies of scale and cuts manufacturing time by eliminating elaborate machining and finishing.

### 3.8 Overview of Investment Casting

Investment casting refers to the ceramics formed around the wax patterns to create a casing for molten metal to be poured. Once the wax patterns are formed, they are melted onto a gate system, dipped into slurry and sand to form a layered casing, then replaced with melted metals such as stainless steel, aluminium, or other metals. The process is described below.

**Exhibit 24b: Production Overview of Investment Castings**




Source: Frost and Sullivan

Investment casting market size is estimated to grow at the CAGR of 7.7% from ~USD 19.7 billion in 2025 to USD 28.5 billion in 2030. Based on the application, the global investment casting market can be categorized into automotive, aerospace & military, oil and gas, energy, medical, and others. investment casting demand is dominated by automotive (~30–35%) and general engineering (~25–30%), followed by energy (~20%), aerospace & defence (~15–20%), and medical/others (<5%).

Super alloys, steel, aluminium, titanium, and other materials have separate segments in the worldwide investment casting market based on the kind of material. Among these, steel today displays blatant market domination. The worldwide investment casting market is largely being driven by the increasing use of investment casting methods to make turbine blades, dental fixtures, automotive components, and other products because they reduce energy and material waste and facilitate the creation of sophisticated patterns

| Acronym | Expansion |
|---|---|
| MIM | Metal Injection Molding |
| CAGR | Compound Annual Growth Rate |
| GDP | Gross Domestic Product |
| FY | Financial Year |
| CY | Calendar Year |
| YOY | Year on year |
| 3D | Three Dimensional |
| PM | Powder Metallurgy |
| Mn | Million |
| Bn | Billion |
| USD | US Dollars |