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Reduction in ENGINEERING, RESEARCH & DEVELOPMENT

CYCLE TIME THROUGH GCC INTEGRATION

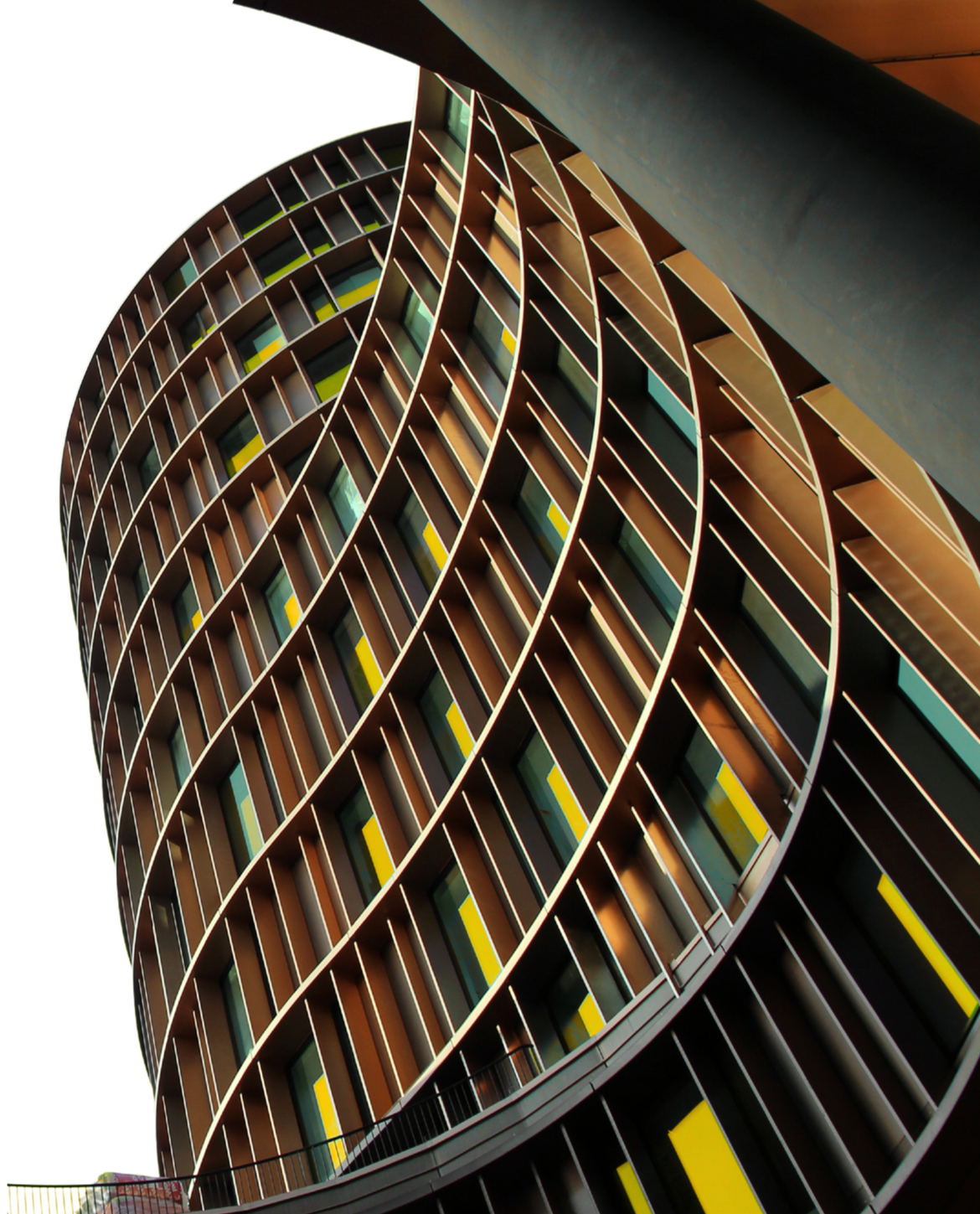
How India's Global Capability Centers Mitigate Challenges in Engineering, Research and Development Functions and Organizations



2026

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From the Desk of CEO

The growing prominence of Global Capability Centers (GCCs) and allied hubs in India, including Offshore Delivery Centers, Back-end Support Centers, Global Innovation Hubs, and Global Delivery Centers, reflects a significant shift in how global enterprises design and execute their operating models. These centers are increasingly contributing to faster engineering and R&D cycles while strengthening enterprise agility and scalability.

Their role now extends beyond operational support to enabling cross-border collaboration, accelerating innovation, and delivering measurable value across industries and geographies. As organizations continue to navigate digital acceleration, cost optimization, and the need for resilient, R&D-led operating models, India has emerged as a strategic location offering scale, specialized talent, and execution speed.

Today, these centers form a core part of enterprise transformation agendas, advancing capabilities across AI, cybersecurity, automation, product engineering, and customer experience. This evolution reinforces India's position as a strategic partner for organizations seeking to enhance competitiveness, strengthen innovation outcomes, and remain agile in an increasingly dynamic global business environment.



Executive Summary

Engineering, Research and Development cycle time refers to the total duration from design initiation to validated completion. It includes design, prototype, simulation, testing, and validation stages. Longer cycle time increases cost and delays product release. Engineering and R&D organizations in the United States, Europe, and Japan face constraints in talent availability, high engineering cost, and limited capacity for parallel execution. These constraints increase development timelines. India based Global Capability Centers support reduction in Engineering, Research & Development cycle time through time zone continuity, workforce scale, and co-location of engineering teams. India hosts over 1,800 GCCs with about 2.1 million professionals. More than 85 percent of the top 50 global Engineering, Research and Development spenders operate GCCs in India.

Time zone differences of 4.5 to 5.5 hours with Europe and 9.5 to 13.5 hours with the United States support continuous execution of engineering tasks. Large engineering teams enable parallel execution of design, simulation, validation, and testing. Co-location of teams reduces delays between engineering stages. GCC operating costs are 40 to 70 percent lower than developed markets.

Patent filings in India increased from 58,507 in 2020 to over 98,000 in 2025. Resident filings increased from 24,303 to 60,000. Non-resident filings remained above 35,000.

Case studies include over 3,800 patent applications from a single GCC. Mercedes Benz Research and Development India employs over 8,500 professionals. Bosch employs over 25,000 professionals in India. Texas Instruments supports semiconductor design and validation from India. Attrition in GCCs declined from 13 percent in 2023 to 9 percent in 2025.

This report covers engineering and R&D cycle time, GCC mechanisms, engineering and R&D activities in India, patent trends, case studies, and challenges in engineering functions and their mitigation through GCCs.



Key Findings

- Over 85 percent of top 50 Engineering and R&D spenders operate GCCs in India.
- Time difference supports continuous execution across regions.
- GCC operations offer 40 to 70 percent lower cost.
- Large teams enable parallel execution of engineering tasks.
- Co-location reduces delays between engineering stages.
- Patent filings in India increased to over 98,000 by 2025.
- Case Studies include over 3,800 patent applications from a single GCC.
- Attrition declined from 13 percent to 9 percent between 2023 and 2025.
- GCCs support reduction in engineering and R&D cycle time across industries.





Engineering and R&D in

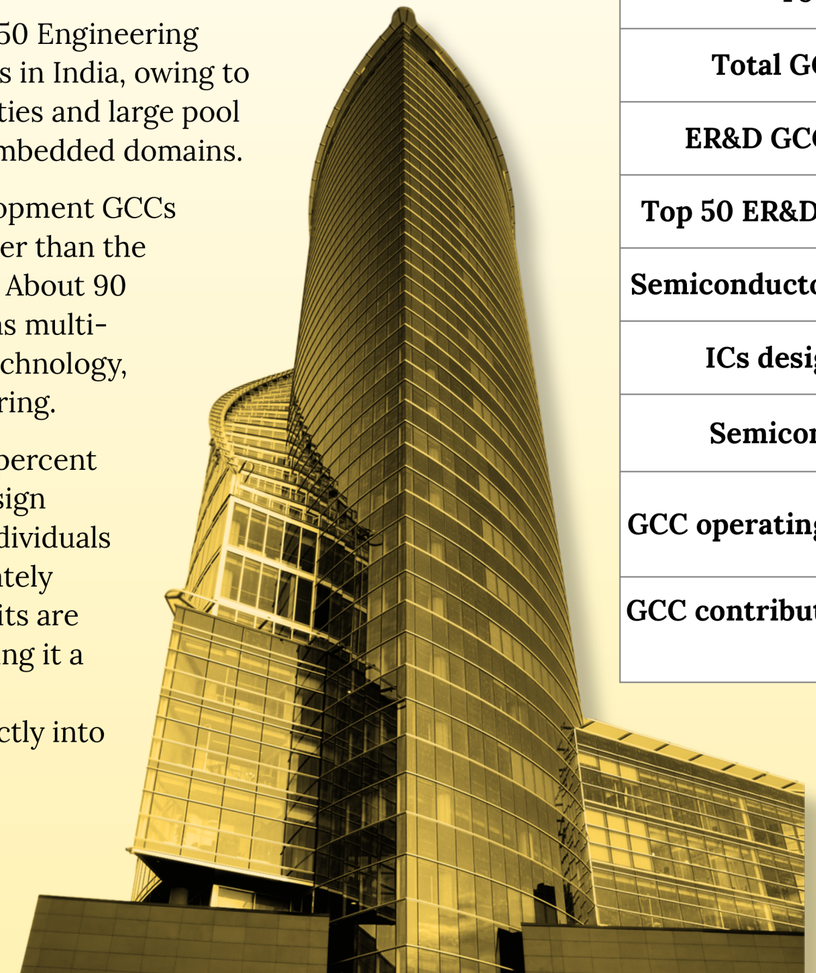
India’s GCC Sector

The scale of India's GCC ecosystem in engineering and R&D functions provides the structural basis for cycle time reduction at an enterprise level.

More than 85 percent of the top 50 Engineering R&D spenders globally have GCCs in India, owing to its software engineering capabilities and large pool of engineers across digital and embedded domains.

Engineering Research and Development GCCs have shown growth 1.3 times faster than the overall GCC growth rate in India. About 90 percent of centers now operate as multi-functional centers, supporting technology, operations, and product engineering.

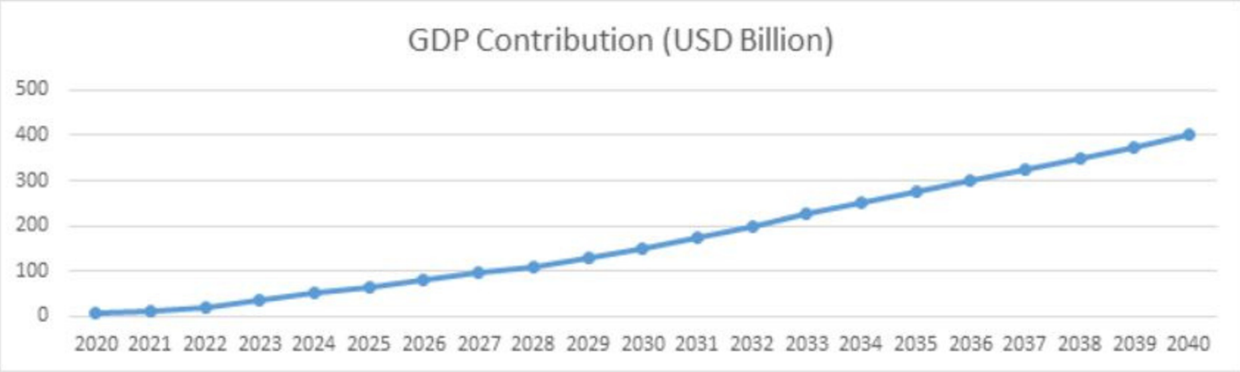
India employs approximately 20 percent of the world's semiconductor design engineers, with about 125,000 individuals working in the sector. Approximately 3,000 individual integrated circuits are designed in India each year, making it a concentrated hub for chip-level engineering work that feeds directly into global product timelines.



Metric	Stats
Total GCCs in India	Over 1,800 centers
Total GCC workforce in India	Approximately 2.1 million professionals
ER&D GCC growth rate vs overall	1.3 times faster
Top 50 ER&D spenders with India GCCs	More than 85%
Semiconductor design engineers in India	Approximately 20% of global total
ICs designed in India annually	Approximately 3,000
Semiconductor GCCs in India	Over 95 units, 50,000+ workforce
GCC operating cost vs developed markets	Approximately 40-70% lower
GCC contribution to India GDP (projected 2030)	USD 100 to 200 billion

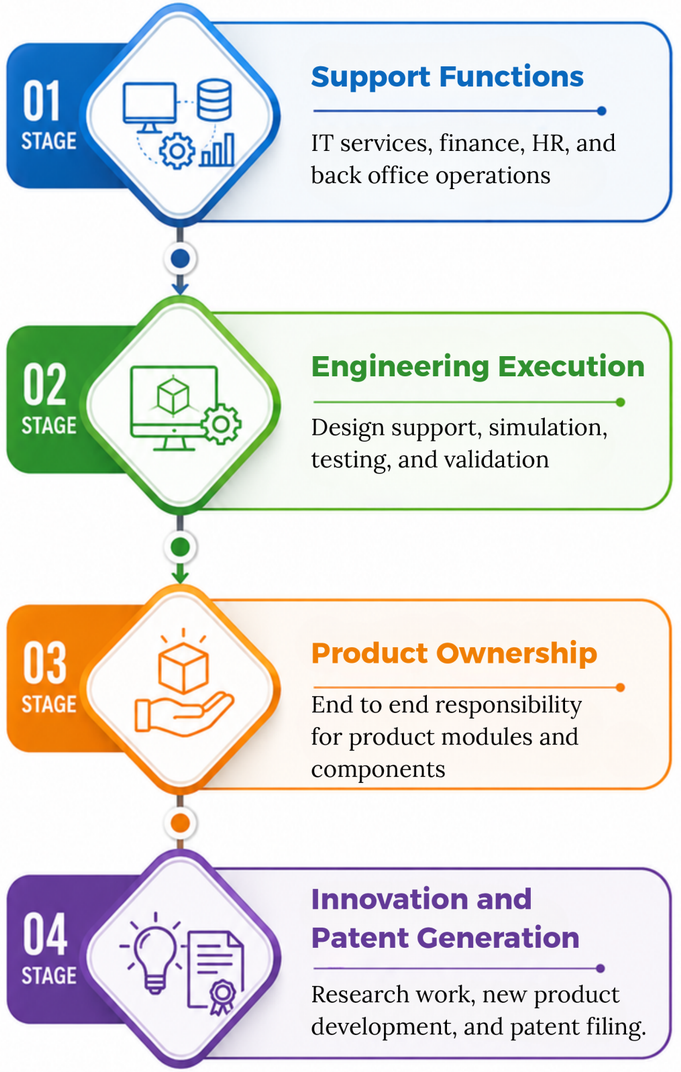
GCC GDP Year Wise Contribution

GCCs are projected to contribute an estimated over USD 400 billion to India's GDP by 2040, with a steady upward trajectory from roughly USD 10–20 billion in the early-2020s. This growth reflects rising GCC scale, higher-value activities (especially in ER&D and semiconductor-design led centers), and deeper integration of GCC-sourced services into India's domestic and export-oriented industrial ecosystem.



GCC Maturity Model

Stage	Description
Stage 1	Support functions
Stage 2	Engineering execution
Stage 3	Product ownership
Stage 4	Innovation and patent generation



Before vs After GCC Impact

Factor	Without GCC	With India GCC
Engineering cycle time	Sequential execution	Parallel execution
Cost	High	40 to 70 percent lower
Team size	Limited	Scalable
Time to market	Longer	Reduced

Sector Wise GCC Impact

Stage	GCC Contribution
Automotive	ADAS, simulation, vehicle design
Semiconductor	Chip design, validation
Aerospace	Engine design, testing
Energy	Turbines, renewable systems



Mechanisms Through Which GCC Integration

Reduces Engineering and R&D Cycle Time

Engineering, Research & Development cycle time in the context of GCC operations covers several specific intervals. These include the time required to complete a design iteration, the time from concept to prototype or specification document, the time between research output and product integration, and the time to complete verification and validation steps before certification or release.

GCCs reduce ER&D cycle time through the following primary mechanisms:

Parallel workstreams enabled by time zone offset

India Standard Time sits is 4.5 to 5.5 hours ahead of Central European Time and 9.5 to 13.5 hours ahead of US time zones. This offset allows India-based teams to continue development tasks after headquarters teams have ended their working day.

Large engineering talent supply at lower cost per engineer

GCCs allow organizations to build engineering teams larger than would be cost-effective at home locations. Greater team scale enables simultaneous execution of multiple workstreams within a single program.

Co-location of multidisciplinary engineering disciplines

Housing engineering, simulation, validation, and testing teams on a single campus eliminates scheduling delays that arise when these disciplines are separated across geographies.

Reduced dependency on external vendors

GCCs enable organizations to carry out engineering, testing, and validation work within internal teams. This reduces delays related to coordination with third parties and shortens handoff time between tasks.

Academic and Government Institution Partnerships

Academic and government institution partnerships support reduction in engineering cycle time by providing access to research, infrastructure, and talent. GCCs collaborate with universities such as Indian Institutes of Technology for research and development work. India produces over 1.5 million engineering graduates annually, supporting staffing needs. Government initiatives such as Digital India and Make in India support infrastructure and industry programs. Access to academic labs and public research facilities reduces time required for testing and validation. These partnerships reduce time required for research, prototyping, and product integration.



Patent Filing Trends in India

Patent filing in India includes resident and non-resident applications. Both contribute to engineering, research and development activities and support the expansion of Global Capability Centers.

Patent filings in India increased from 58,507 in 2020 to over 98,000 in 2025. This shows steady growth in total filings across the period.

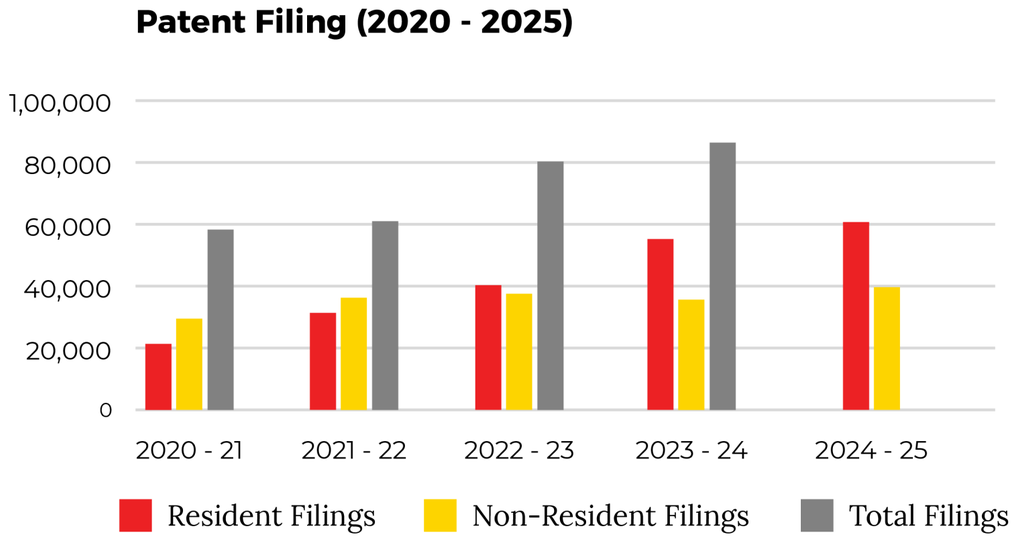
Resident filings increased from 24,303 in 2020 to 60,000 in 2025. This indicates an increase in domestic research and engineering activity. Higher resident filings indicate availability of local engineering talent and research capability, which supports GCC operations.

Non-resident filings increased from 34,204 in 2020 to around 38,000 in 2025. The share of resident filings increased over time, while non-resident share has shown continuity. In 2020, non-resident filings were higher than resident filings. These filings are largely driven by multinational companies operating engineering and research centers in India.



Total filings increased each year, with the largest increase between 2021 and 2023. This reflects higher patent activity across both domestic and foreign organizations. Both resident and non-resident filings contribute to overall patent growth and reflect engineering and research work carried out in India.

Resident filings support GCCs by providing access to local talent and research output. Non-resident filings support GCCs by reflecting engineering work carried out by foreign organizations through India based centers. Patent filings from both categories indicate execution of design, testing, and development work in India. This supports expansion of GCCs across sectors such as semiconductor, automotive, aerospace, and energy.



Patent Filing in India by Developed Markets and Associated Benefits through Global Capability Centers

Factor	United States	Europe	Japan	United Kingdom	Key Stats
Cost of R&D	Lower engineering cost supports higher patent volume	Lower development cost supports industrial design work	Reduces cost of electronics and semiconductor R&D	Lower software development cost supports filings	40 to 60 percent lower operating cost
Engineering talent availability	Large teams for software and semiconductor design	Strong talent for automotive and manufacturing	Talent supports electronics and chip design	Talent supports digital and fintech development	Over 1.5 million engineers annually
GCC based execution	Product development carried out in India GCCs	Engineering and testing handled through GCCs	Design and validation executed through GCCs	Software and product work handled in GCCs	Over 1,800 GCCs in India
Faster development cycles	Continuous work across time zones	Reduced time between design and testing	Faster validation of electronics systems	Faster software development cycles	4.5 to 13.5 hour time difference
Parallel workstreams	Multiple product programs run at same time	Parallel engineering across functions	Parallel chip design and testing	Parallel software and product development	Large team sizes enable parallel work
Internal IP ownership	Patents filed under company ownership	Direct control over industrial designs	Control over semiconductor IP	Ownership of software and digital IP	GCCs operate as captive centers
Reduced vendor dependency	In house engineering reduces external reliance	Internal teams handle testing and validation	Internal execution reduces delays	Internal teams handle development work	Reduced coordination time
Access to infrastructure	Use of labs and testing facilities	Access to manufacturing and testing setups	Access to semiconductor design tools	Access to digital and IT infrastructure	Established tech hubs
Academic collaboration	Partnerships with IITs and research institutions	Collaboration with technical universities	Collaboration for electronics research	Collaboration for software research	Academic and industry linkages
Scalability of operations	Large teams support multiple filings	Supports large scale industrial programs	Supports high volume chip design	Supports scaling of digital products	Workforce of 2.4 million in GCCs

Illustrative GCC

Case Studies

01 General Electric: John F. Welch Technology Centre

General Electric is a multinational organization operating in aviation, healthcare, power, and energy sectors. It conducts engineering and research activities across global locations to support product development and industrial operations. General Electric established its John F. Welch Technology Centre (JFWTC) in Whitefield, Bengaluru on September 17, 2000.

Establishment and GCC Location

General Electric established its John F. Welch Technology Centre (JFWTC) in Whitefield, Bengaluru on September 17, 2000, with an initial investment of about USD 220 million. The center employs more than 5,000 engineers, scientists, and researchers. The center was the first and largest integrated, multidisciplinary R&D center for GE outside the United States. Following GE's 2024 corporate split, the center now supports **GE Aerospace, GE Healthcare, and GE Vernova (Power and Energy).**

Functions Handled

The center supports engineering, research and development activities across aviation, healthcare, power, and energy businesses. It carries out design, simulation, testing, validation, and product development work. Multiple engineering disciplines including materials science, mechanical engineering, electronics, and software are co-located within the same campus.



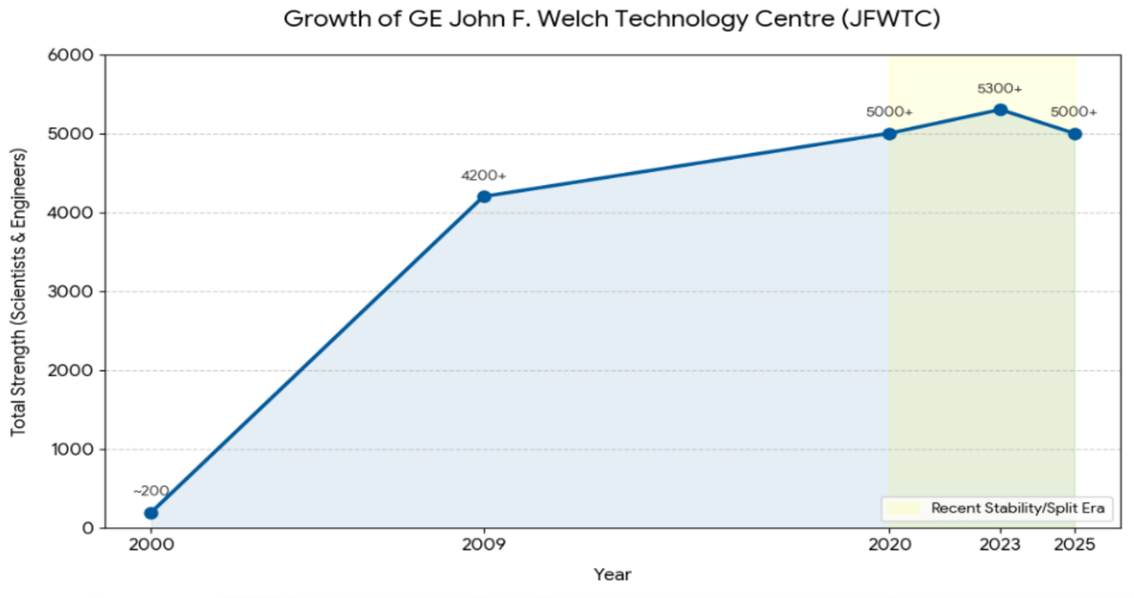
Engineering and R&D Cycle Time Outcomes

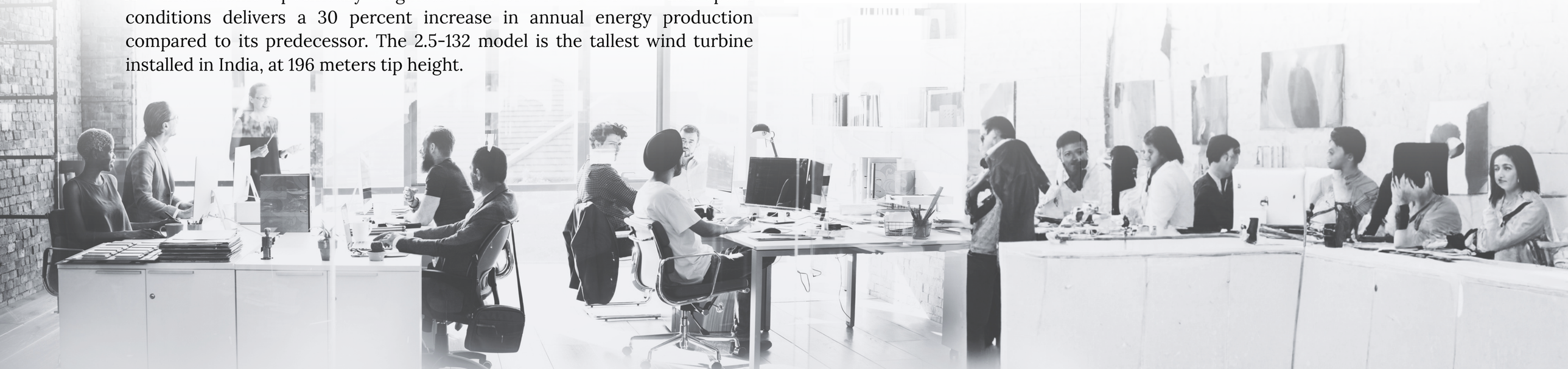
The center has produced more than 3,800 patent applications over about 25 years. Workforce increased from 200 to over 5,000, enabling execution of multiple engineering programs at the same time. The center has contributed to development of aircraft engines, healthcare equipment, and power systems deployed across global markets.

Every GE engine launched or certified since the center's establishment in 2000 has had input from the Bengaluru team, including the CFM LEAP, GEnx, and GE9X engines used in both wide-body and narrow-body commercial aircraft.

The center developed an advanced combustor system for the GEnx engine, delivering reduced NOx emissions and a 20 percent increase in fuel burn efficiency. The center also contributed to the H-class gas turbine, which holds a world record at over 64 percent combined-cycle efficiency.

A wind turbine specifically engineered at JFWTC for low wind speed conditions delivers a 30 percent increase in annual energy production compared to its predecessor. The 2.5-132 model is the tallest wind turbine installed in India, at 196 meters tip height.





Outcome Metric	Reported Figure
Total patent applications contributed	Over 3,800
Aviation patents alone	Over 1,000
GEnx combustor fuel efficiency gain	20% improvement
Wind turbine annual energy output vs predecessor	30% increase
9HA gas turbine combined-cycle efficiency	Over 64%
Community lives reached (2019)	300,000
Gas turbines deployed: Thailand	1,400 MW (2 units)
Gas turbines deployed: Malaysia	3.5 GW (5 units)
Gas turbines deployed: Indonesia	2,540 MW (2 units)

How Challenges Mitigated

Multi-vertical parallel R&D

JFWTC staffs parallel research programs across aviation, power, healthcare, and renewables simultaneously from one campus, a scale not feasible from a single headquarters location without prohibitive cost.

Emerging market product development

JFWTC co-developed Lullaby Warmers and LED phototherapy devices with input from rural health centers in India and Bangladesh, producing affordable healthcare products deployed across ASEAN.

IP generation at scale

JFWTC contributed to 3,800 or more patent applications across 25 years, including over 1,000 aviation patents alone.

Academic co-development

JFWTC partnered with IIT Madras to develop Cold Spray SMART additive repair technology, extending R&D capacity beyond the internal team.



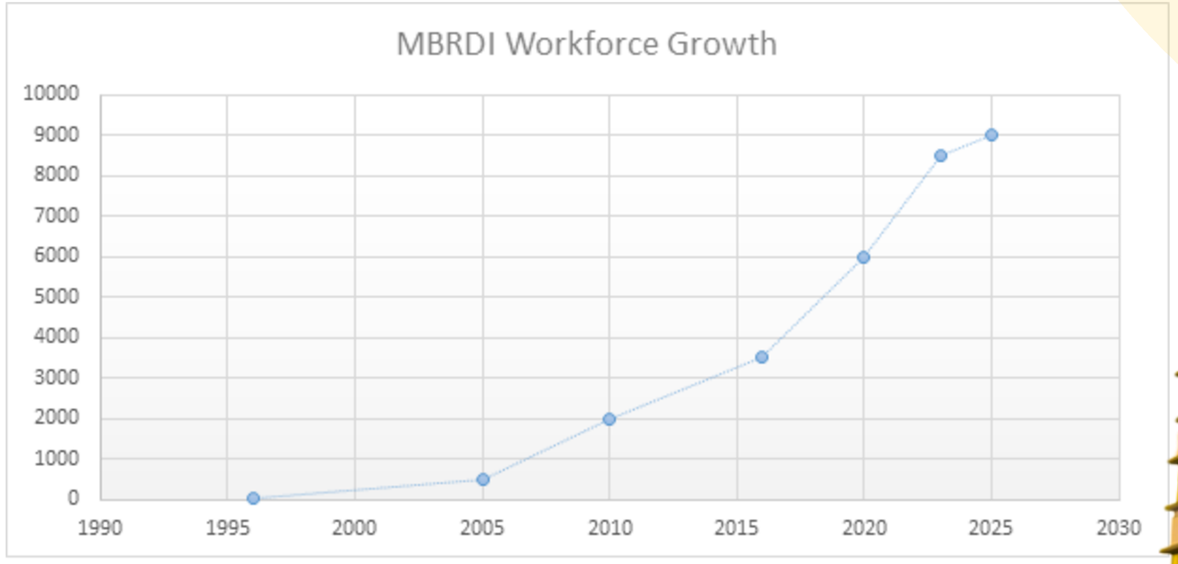
02 Mercedes Benz Group: MBRDI

Mercedes Benz operates in the automotive sector and conducts engineering and research activities for vehicle design, development, and testing across global markets.

Establishment and GCC Location

Mercedes Benz established Mercedes Benz Research and Development India in Bengaluru in 1996. The center started with about 10 employees and has expanded to over 8,500 professionals. It is the largest research and development center of Mercedes Benz outside Germany.

MBRDI was established in Bengaluru in 1996 as a captive unit to support Mercedes-Benz research, IT, and product development activities. It is the largest research and development center for Mercedes-Benz Group AG outside Germany. The center employs over 8,500 professionals in engineering, digitalization, testing and simulation, and data science. A satellite office in Pune specializes in interior component designs and IT engineering.





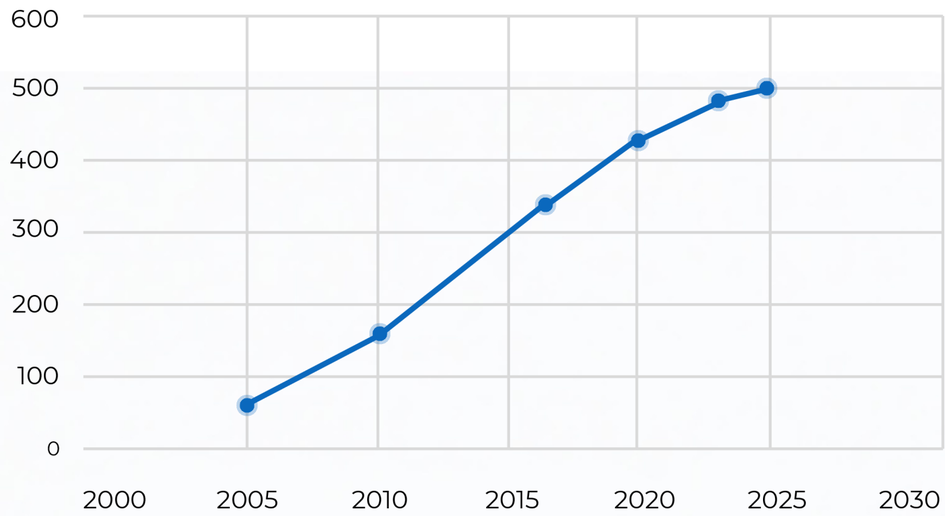
Functions Handled

The center supports product engineering, vehicle design, software development, testing, and validation. It works on powertrain systems, body engineering, electronics, and digital systems. Engineering teams in India contribute to multiple stages of vehicle development including design, simulation, and testing.

Engineering and R&D Cycle Time Outcomes

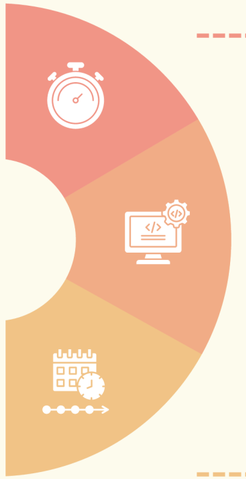
Important components of the digital dependencies in Mercedes-Benz's overall global product development are located at MBRDI. Engineering decisions that previously required routing back to Germany are made in India, removing latency from the decision and approval cycle.

MBRDI filed 50 patent applications in 2012 alone. By the center's 20th anniversary, the India center had produced close to 500 patent applications. The Human Body Modelling simulation tool was developed in close collaboration between MBRDI and German R&D sites, demonstrating how joint development between India and headquarters teams reduces the time required for complex simulation tool development.





How Challenges Mitigated



Decision latency:
Product engineering decisions for global vehicle programs are made in Bengaluru, eliminating round-trip communication delays to Stuttgart.

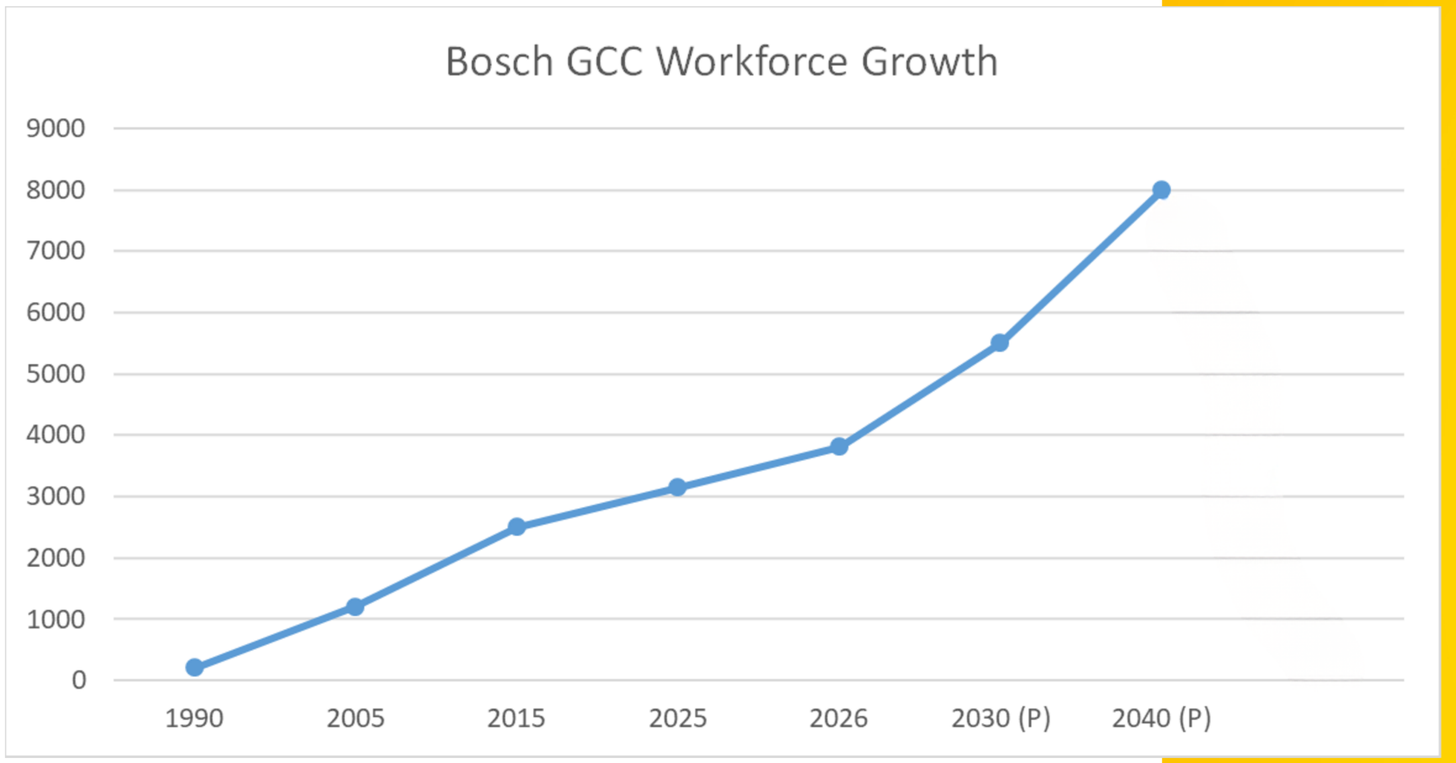
Program scale:
The center grew from 10 employees in 1996 to over 8,500, supporting concurrent programs across vehicle design, CAE simulation, software development, and data science.

Engineering timeline compression:
Flexible hybrid engineering teams accelerated project timelines across vehicle connectivity, autonomous systems, digital cockpit, and enterprise engineering tools.



03 Bosch Global Software Technologies

Bosch is a German multinational engineering and technology company with one of the largest GCC presences in India. The company uses a captive GCC model to maintain governance alignment and decentralized execution across engineering and software functions. Bosch invested Rs 2,000 crore (USD 260 million) by 2025 to 2026, with half allocated to advanced automotive technologies and half to digital mobility solutions. The company employs over 25,000 professionals in India.



Establishment and GCC Location

Bosch established its presence in India in 1951. The company set up engineering and research operations to support global product development and manufacturing activities. Bosch India operations form a significant part of its global engineering and research network outside Germany. Bosch operates Global Capability Centers in India through its engineering and technology units. Major locations include Bengaluru, Hyderabad, Coimbatore, and Pune and Bengaluru is the largest engineering and research location. Bosch employs more than 25,000 professionals in India across engineering, software, and research functions and large share of the workforce is based in Bengaluru.



Functions Handled

Bosch Global Capability Centers in India handle engineering and research activities including product design, software development, and system integration. The centers support development of automotive systems, embedded software, and electronic control units. Teams perform simulation, testing, and validation of components and systems before release. The centers also support documentation, design updates, and lifecycle management of engineering programs.

Engineering and R&D Cycle Time Outcomes

Bosch's India unit is a pioneer in global Advanced Driver Assistance Systems (ADAS) development. The India-based engineering team contributes to ADAS work that feeds into vehicle programs across multiple automotive manufacturers worldwide. The India centers support development of automotive systems including advanced driver assistance systems and embedded software used in global products. The centers contribute to patent filings and engineering outputs as part of Bosch global research network. India operations support product development for multiple markets, with engineering work completed across design and testing stages within defined timelines.

Co-location of teams and internal execution of engineering work reduce dependency on external vendors and shorten overall development cycles.

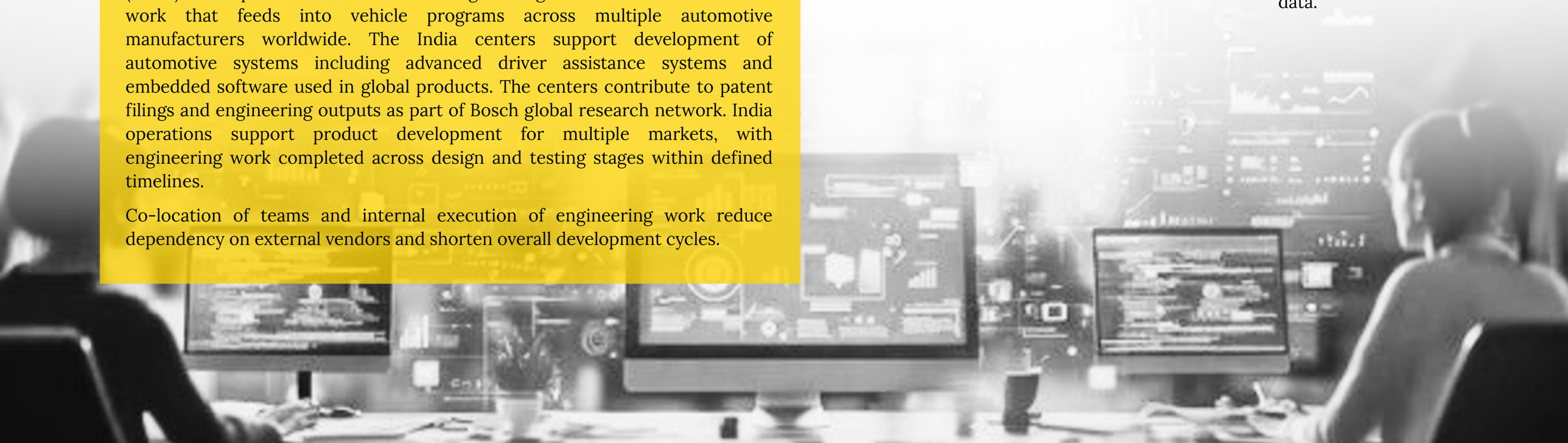
How Challenges Mitigated

ADAS program scale

ADAS development requires large-scale data annotation, algorithm validation, simulation, and testing cycles across multiple regulatory environments. Bosch's 25,000-person India workforce runs these workstreams at a scale not available from European locations alone.

Captive IP control

The captive model gives Bosch direct control over IT infrastructure, access policies, and personnel screening, maintaining IP security for sensitive product engineering data.

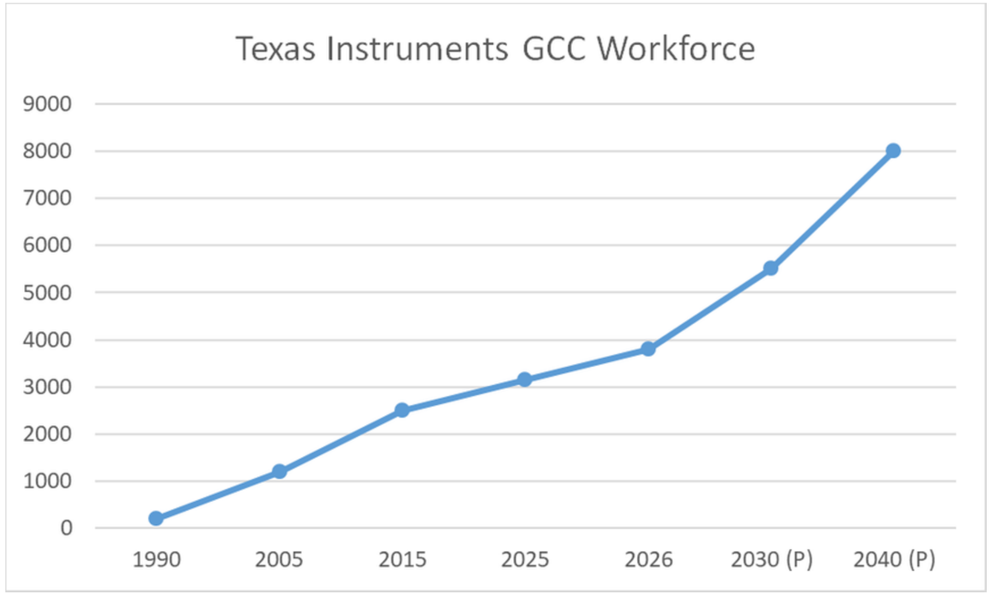


04 Texas Instruments

Texas Instruments is a semiconductor company that designs and manufactures analog and embedded processing chips. The company was founded in 1930 and is headquartered in the United States. It supplies semiconductors used in automotive, industrial, consumer electronics, and communication systems. Texas Instruments operates engineering and research centers across multiple countries, including India, to support global product development and chip design activities.

Establishment and GCC Location

Texas Instruments established the first GCC in India in Bengaluru in 1985. The center focuses on semiconductor design, software development, and engineering services for analog and embedded processing products. In 2026, Texas Instruments opened a new advanced semiconductor research and development center in Bengaluru, expanding its chip design operations. The new facility includes multiple integrated circuit design laboratories and an end-to-end reliability laboratory designed to test semiconductor products under varied environmental conditions. Texas Instruments states the center strengthens its work in analog and embedded processing technologies and improves its ability to support customers and the electronics design ecosystem in India.





Functions Handled

Texas Instruments Global Capability Center in India handles semiconductor engineering and product development functions. The center supports integrated circuit design for analog and embedded processing chips used in automotive, industrial, and consumer electronics applications. Engineering teams carry out circuit design, layout design, simulation, and validation of semiconductor components. The center also supports development of embedded systems and software associated with chip functionality. Testing and verification activities are performed to ensure performance and reliability before product release. The India center contributes to documentation, design support, and lifecycle management of semiconductor products.

Engineering and R&D Cycle Time Outcomes

Texas Instruments has been advancing semiconductor technology for Electric Vehicles, introducing three chips at CES 2024 designed for the next generation of automobiles. These include radar sensors for Advanced Driver Assistance Systems and programmable driver chips for Battery Management Systems. The India center contributed to the engineering work underlying these product releases.

How Challenges Mitigated

Texas Instruments has been advancing semiconductor technology for Electric Vehicles, introducing three chips at CES 2024 designed for the next generation of automobiles. These include radar sensors for Advanced Driver Assistance Systems and programmable driver chips for Battery Management Systems. The India center contributed to the engineering work underlying these product releases.



Verification cycle compression

India teams pick up verification workstreams at the end of the US working day, extending the productive verification window and compressing calendar time for a complete verification run.

Talent pipeline

TI established collaborations with IIT Madras, IIT Bombay, and the Indian Institute of Science for VLSI design programs, creating a continuous supply of engineers trained for semiconductor design roles at the center.

Product diversification

The center contributed to chips for Electric Vehicle applications including radar sensors for Advanced Driver Assistance Systems and Battery Management Systems.



Challenges in Engineering & R&D FUNCTIONS

How GCCs Mitigate Them



01 Talent Scarcity in HQ Locations

Engineering and R&D organizations in the United States, Germany, Japan, and Western Europe face constrained supply of experienced engineers across software, embedded systems, semiconductor design, simulation, and data science. Hiring timelines are long, compensation costs are high, and attrition is increasing in competitive sectors.

GCC Mitigation

More than 1.5 million engineers graduate in India every year, with more than 50% trained in fields relevant to emerging technology. Stanford's AI Index 2024 ranks India among the top countries globally for technical talent output. India's talent pipeline is large enough to staff engineering teams at a scale that would not be achievable in most headquarters markets within comparable timelines or budgets.

02 Rising Engineering Labor Costs

Engineering compensation in developed markets has increased substantially, compressing R&D budgets and limiting the number of parallel workstreams organizations can sustain.

GCC Mitigation

India offers approximately 50 percent lower operating costs compared to developed markets. This cost structure allows organizations to staff parallel engineering programs simultaneously across research, design, validation, and testing phases without proportionate increases in budget.



03 Intellectual Property Concentration Risk

Organizations that concentrate their engineering and patent activity in one or two headquarters locations create geographical and workforce concentration risk. A talent market disruption, regulatory change, or workforce reduction in one location can halt entire product development programs.

GCC Mitigation

A case GE's JFWTC showed that the organization contributed to over 3,800 patent applications from the India campus, embedding India-based engineers directly into the global patent generation process. JFWTC integrates into GE's global IP strategy through collaborative filing, where inventions developed in Bengaluru are co-authored with international teams and filed under GE's unified patent system. This distributes IP generation across geographies.

04 Extended Time-to-Market on Complex Projects

Complex engineering programs such as aircraft engine certification, automotive platform development, and semiconductor chip tapeout have development cycles measured in years. Each delay in a sub-task adds calendar time to the overall program.

GCC Mitigation

The geographic offset between India and US or European headquarters enables tasks to proceed in near-continuous cycles. Simulation results, code reviews, test logs, and documentation can be produced during India working hours and reviewed at headquarters at the start of the next working day. This operating model compresses what might take several calendar weeks of sequential back-and-forth into a shorter real-time cycle.



05 Talent Attrition in GCCs

66 percent of GCCs report difficulty in attracting niche technical talent, and 54 percent face rising compensation costs. These challenges create continuity risk for engineering projects that depend on accumulated domain knowledge held by individual engineers.

GCC Mitigation Progress

Attrition across GCCs in India has declined from 13% in 2023 to 11% in 2024 and further to 9% in 2025. This reflects improvements in retention through structured talent development, career pathing, and hybrid work arrangements. Organizations with established career mobility pathways and rotational programs between India centers and global roles have recorded the strongest retention outcomes.



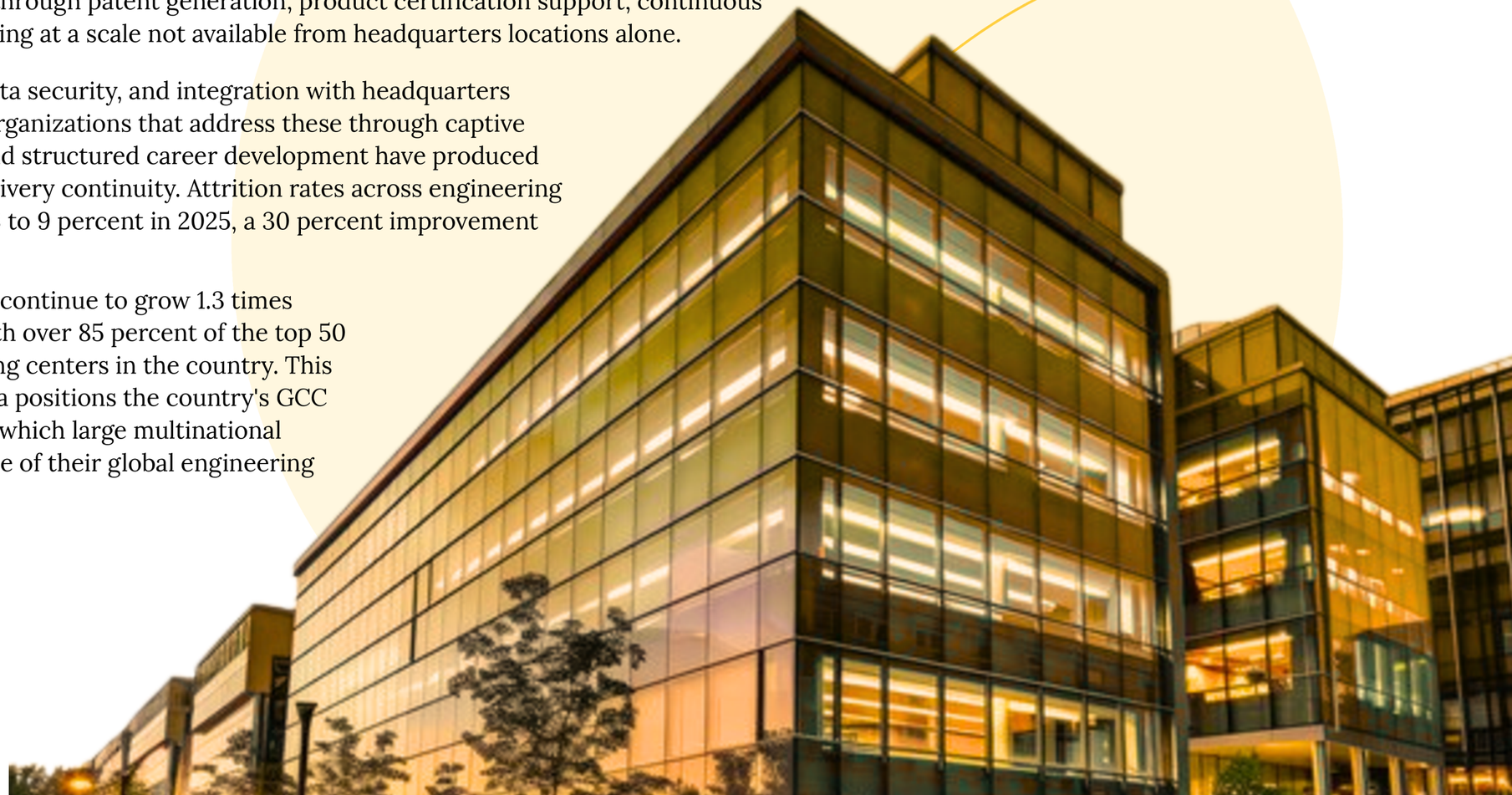
Conclusion

India's GCCs reduce engineering cycle time primarily through three verifiable mechanisms: extended development hours enabled by time zone positioning, workforce scale at lower per-engineer cost than headquarters markets, and co-location of multidisciplinary teams within integrated campuses. These mechanisms directly address the most common constraints on engineering program speed: talent availability, parallel workstream capacity, and the elapsed time required to complete iterative technical tasks.

Case examples from General Electric, Mercedes-Benz, Texas Instruments, and Bosch confirm that GCCs in India contribute to reduced engineering cycle time through patent generation, product certification support, continuous development cycles, and parallel program staffing at a scale not available from headquarters locations alone.

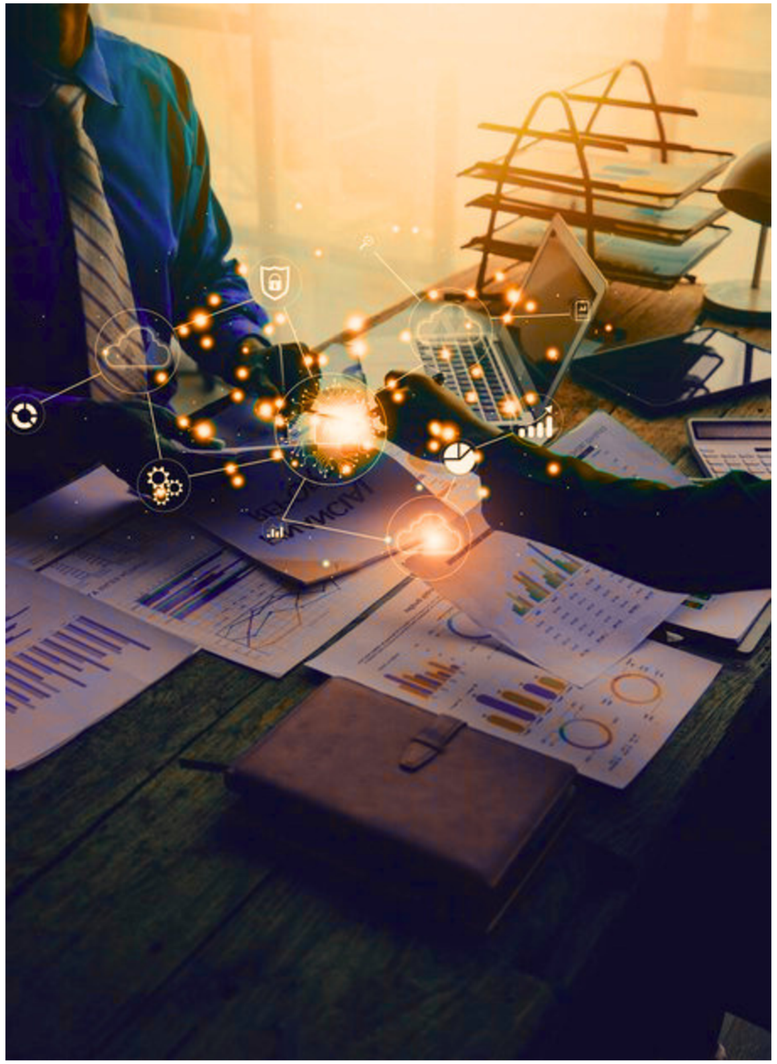
The structural challenges of talent attrition, data security, and integration with headquarters teams remain active management priorities. Organizations that address these through captive structures, cross-border team composition, and structured career development have produced measurable improvements in retention and delivery continuity. Attrition rates across engineering GCCs in India declined from 13 percent in 2023 to 9 percent in 2025, a 30 percent improvement over two years.

Engineering Research and Development GCCs continue to grow 1.3 times faster than India's overall GCC growth rate, with over 85 percent of the top 50 global Engineering R&D spenders now operating centers in the country. This concentration of engineering capability in India positions the country's GCC ecosystem as the primary instrument through which large multinational organizations manage the speed, cost, and scale of their global engineering programs.



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Inductus GCC's Digital Twin and COPO (Company-Owned, Partner-Operated) Service Model creates a seamless, future-ready operational framework for global businesses setting up GCCs in India. The Digital Twin Process ensures real-time collaboration, decision-making, and operational efficiency by replicating physical systems in a virtual environment, enabling synchronized execution across multiple time zones. Meanwhile, the COPO Model allows MNCs to retain full ownership and strategic control while leveraging Inductus' expertise for execution, compliance, and scalability.

This hybrid approach optimizes costs, mitigates risks, and accelerates GCC growth, ensuring innovation-driven operations with minimal liabilities and maximum efficiency.


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