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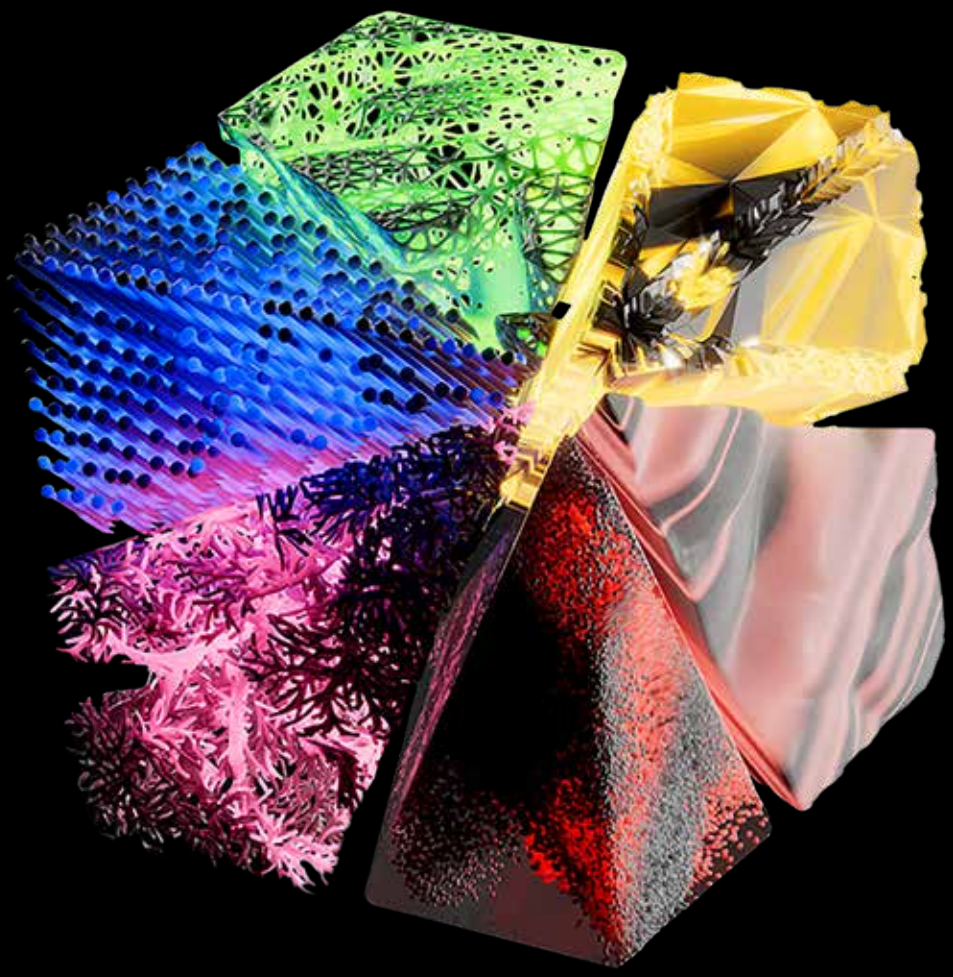

Deloitte technology trends 2024: India perspective

April 2024

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Executive summary

The Deloitte Tech Trends 2024 report reveals the forefront of pioneering technologies adopted by forward-thinking organisations, uniquely viewed through an Indian lens. It provides captivating insights into potential industry game-changers for Indian business leaders and organisations.

In 2024, India's technology landscape will pulsate with innovation, reflecting a rich tapestry woven from tradition and cutting-edge advancements. From the bustling streets of Mumbai to the tech corridors of Bengaluru, a dynamic symphony of trends unfolds, reshaping industries and redefining norms.

The synergy between elevating and grounding forces is the key to this change. Elevating forces, fueled by interaction, information, and computing, serve as catalysts for innovation, propelling industries towards uncharted territories. These forces herald the rise of transformative technologies such as spatial computing (allowing virtual worlds to blend with the real world) and Generative AI (GenAI), that gives organisations access to new insights and creative potential). Simultaneously, grounding forces, including the business of technology, core modernisation, security, and trust, provide the necessary foundation for sustainable growth. Investments in modernising core systems and bolstering cybersecurity infrastructure ensure seamless integration of new technologies while safeguarding against emerging threats. As technology evolves, DevOps undergoes a paradigm shift, prioritising the empowerment of developers through developer experience (DevEx). This transition fosters a culture of innovation and collaboration, driving efficiency and creativity in software development.

However, amidst the wave of innovation, the challenge of navigating an era dominated by synthetic media looms large. The quest for truth becomes paramount, requiring strategies to discern authenticity in a landscape inundated with manipulated content. Furthermore, the transition from managing technical debt to prioritising technical wellness emerges as a guiding principle, fostering sustainable technology ecosystems that can adapt and thrive in the face of evolving challenges.

The technology landscape in India, with bold plays from the supply and demand sides

India's technology and tech services industry

India stands out as a hub of innovation and opportunity in a constantly changing landscape, where tradition and modernity converge to create a vibrant ecosystem full of possibilities. The country is set to take the lead in advancing a future characterised by technological prowess and inclusive growth as more organisations recognise the potential of emerging technologies and adopt innovative cultures.

FY2023 was a difficult year due to uncertainties, macroeconomic and geopolitical challenges, and a global slowdown. Despite that, the Indian tech industry demonstrated resilience and continued to strengthen its position as a trusted global technology leader over the past two years. The Indian technology industry's revenue (including hardware) is estimated to reach US$254 billion (3.8 percent y-o-y growth) in FY2024, up by US$9 billion over the last year. Exports are poised to touch the US$200 billion mark, growing at 3.3 percent y-o-y, and the domestic technology sector is expected to cross US$54 billion, growing at 5.9 percent y-o-y.[1]

Global Capability Centers (GCCs) are taking the lead in 2024, demonstrating India's growing prowess in catering to international tech needs. With over 1,600 GCCs currently, India's GCC market is growing and creating its dominance globally. It is estimated that by 2030, the Indian GCC market would exceed US$100 billion, with ~2,500 GCCs across the country employing over 4.5 million people.[2] There is also a strong focus on Engineering Research and Development (ER&D), positioning India as a global tech hub for cutting-edge solutions. ER&D contributed 48 percent, or US$2.88 billion, to the US$6 billion export revenue addition in FY24 from the financial year ended March 2023. This robust ecosystem fosters innovation across diverse sectors.[2]

[1] https://nasscom.in/knowledge-center/publications/technology-sector-india-strategic-review-2024

[2] https://www.businessworld.in/article/Tech-Outlook-What-Is-India-Gearing-Up-For-In-2024-/01-01-2024-504159#:~:text=By%202030%2C%20the%20GCC%20market,up%20as%20'centres%20of%20excellence

Tech demand in India

India remains the fastest-growing economy in the world. Deloitte estimates the Indian economy to grow by 6.9–7.2 percent or more due to the robustness of the country's industrial sector. The momentum will be strong as the world recovers later in 2024, and India will see much higher economic growth.[3]

There is a close connection between technological adoption and accelerated economic growth. Improved accessibility and government initiatives have led to a significant surge in digital technology adoption. According to the Deloitte India Pre-Budget Survey 2024, more than 90 percent of businesses are adopting technologies such as AI, ML, and IoT (the most widely used include chatbots and virtual assistants, followed by ML algorithms). However, a significant 62 percent underscores the need for clear regulations for using these technologies and suitable training for the workforce.[4] Technology demand is growing across businesses with, advanced technologies offering avenues for growth and efficiency, such as automating tax filing, using blockchain for secure financial transactions, and digitizing government processes.

The NASSCOM Annual Enterprise & Tech Services CXO Survey 2024 indicates stronger growth momentum for CY2024, with sectors such as BFSI, telecom, media and entertainment, and hi-tech leading digital spending.[1] According to Gartner, technology spending is expected to grow by 11 percent in 2024. Indian businesses are looking to collaborate with external providers in areas such as AI, industry cloud, security, and data analytics, resulting in increased IT spending in 2024.[5]

According to the Deloitte India economic outlook, January 2024, India's focus is on leveraging technology to accumulate and diffuse tacit knowledge, coupled with efforts to enhance high-end manufacturing capacity and bolster competitiveness through exports. This has significantly propelled the country's growth trajectory and bolstered its economic fundamentals over the years.

Driving force propelling technology adoption and growth

India's tech landscape is experiencing a surge, driven by

[3] https://www2.deloitte.com/us/en/insights/economy/asia-pacific/india-economic-outlook.html

[4] https://www2.deloitte.com/in/en/pages/tax/articles/deloitte-pre-budget-survey-2024.html

[5] https://www.gartner.com/en/newsroom/press-releases/2023-11-28-gartner-forecasts-india-it-spending-to-grow-11-percent-in-2024

multiple factors. The interim budget for 2024–2025 stressed establishing a technology-focused roadmap for Viksit Bharat by 2047.[6] Government initiatives fostering innovation, paired with policies encouraging foreign investments, fortify the industry's resilience and set the stage for sustained growth. Investments are being made to build a solid foundation for India's capabilities, both in terms of skills and infrastructure. Government incentives, subsidies, and increased adoption of technology use cases will shape India's growth in the next fiscal year.

Under Digital India, initiatives such as MeghRaj (the government's cloud initiative), IndiaAI, and Digital Public Infrastructure together propel digital adoption in India. While cloud computing is increasingly being adopted, technological advancements such as metaverse, AI, quantum computing, and supercomputing are on the rise. This is coupled with a strong focus on data privacy, security, and trust, thanks to regulations such as the DPDP Act. The Indian government recently set aside a corpus fund to drive innovations in AI through public-private partnerships, where ethical AI is one of the key focus areas. Emphasis on sustainability and manufacturing creates a fertile ground for tech companies to thrive.

Per Deloitte's "India's US$5 trillion goal: Insights from business leaders" survey in January 2024, more than 90 percent of businesses use AI/GenAI with ~50 percent of them indicating very well execution, while only 2 percent businesses extensively use the technology. GenAI can accelerate India's digital transformation.[7] To drive technological advancement and maximise service transformation, organisations must invest in using GenAI effectively, in line with changing market dynamics. While there was substantial interest in this technology in 2023, 2024 is set to focus on identifying investment areas and evaluating the outcomes of existing investments. The promises that GenAI holds can be impaired by inherent risks such as misinformation and synthetic media. Enterprises must manage GenAI-related risks to avoid any reputational or financial loss by proactively comprehending and integrating processes for risk mitigation and governance.

From a talent standpoint, factors such as software exports, tech workforce, tier-2 city expansion, government assistance, and improved infrastructure are solidifying India's evolving value proposition as a reliable and skilled tech talent pool. Increased emphasis on attracting and retaining the best talent pool and giving them the best developer experience is central to creating a compelling narrative for continued growth and leadership in the global tech landscape.

The Deloitte Technology Trends 2024[8] Report provides businesses and industry leaders insights into the ever-evolving technology landscape. It aims to highlight the technologies that in the next 12–24 months will be the new normal and trends that are primed at rapidly improving the human-machine experience and enhancing organisational efficiency if embraced in time and implemented correctly.

[6] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2001136

[7] https://www2.deloitte.com/content/dam/Deloitte/in/Documents/tax/in-tax-deloitte-pre-budget-study-1-23-Jan-2024-noexp.pdf

[8] https://www2.deloitte.com/us/en/insights/focus/tech-trends.html

Tech trends for 2024
Elevating forces

Trend 1: Interfaces in new places: Spatial computing and industrial metaverse

Spatial computing merges the physical and digital worlds, creating an opportunity for the industrial metaverse, where Augmented Reality (AR) and Virtual Reality (VR) enhance productivity.

Spatial computing and metaverse represent the convergence of digital and physical realities, offering immersive and interactive experiences that redefine human-computer interaction. These technologies have emerged as groundbreaking technologies with the potential to reshape industries globally. The 2023 Tech Trends report had projected that the metaverse/spatial computing would see a transformation from an entertainment-centric tool to an enterprise tool. Now that hardware is more capable of spatial mapping and processing high-fidelity 3D assets, this transformation into an enterprise-ready productivity tool is well underway.[1]

Metaverse fosters innovation, allowing businesses to create interactive experiences, simulate scenarios, and prototype designs seamlessly. It revolutionises industries such as manufacturing, design, and logistics by enabling real-time data visualisation, remote collaboration, and immersive training. As spatial computing evolves, it promises to redefine how industries operate, facilitating seamless integration of virtual and physical environments for enhanced productivity and creativity. In India, tech companies pioneer adoption, transforming sectors such as banking, retail, healthcare, manufacturing, automotive, and education. Innovations range from virtual banking experiences and AR-based retail solutions to product design, manufacturing installations, supply-chain inventory management, and immersive medical training. India is expected to make its mark in spatial computing, with a projected revenue of US$2.1 billion in 2024 and a CAGR of 40.03 percent during 2024–2030.[2]

In India, a hotbed of technological innovation, companies are spearheading the adoption and development of spatial computing and metaverse solutions, leading to innovative use cases across sectors. The market potential of spatial computing and the metaverse in India is significant, driven by several factors. First, India's thriving tech ecosystem and expertise in software development provide a strong foundation for innovation and adoption. With a large pool of skilled engineers and developers, Indian companies are well-positioned to capitalise on emerging technologies such as spatial computing. Second, the increasing penetration of smartphones and internet connectivity, including 5G, across India's population fuels the demand for immersive and interactive digital experiences. As more people gain access to devices capable of supporting spatial computing applications, the market for these technologies is expected to grow rapidly. Moreover, government initiatives aimed at promoting digital innovation and entrepreneurship create a conducive environment for the growth of spatial computing in India. Policies supporting technological R&D and initiatives to bridge the digital divide further stimulate market growth. Additionally, COVID-19 accelerated the adoption of digital technologies, including spatial computing, as businesses sought remote collaboration tools and virtual solutions to adapt to the new normal. This trend is expected to persist after the pandemic, driving sustained demand for spatial computing solutions in India.

Leading companies are embracing spatial computing and the metaverse to drive digital transformation and create value in diverse sectors. The most prominent fields to use the capabilities of spatial computing in industrial applications are the banking, retail, healthcare, manufacturing, automotive, and education sectors.

In the banking sector, spatial computing and the metaverse have revolutionised customer experiences and operational efficiency. One of the largest technology service providers in India has developed immersive VR solutions for branch

[1] https://www2.deloitte.com/us/en/insights/focus/tech-trends.html#interfaces-in-new-places
[2] https://www.statista.com/outlook/amo/metaverse/india

transformation, enabling banks to offer personalised services through virtual branches. Another large Indian bank has introduced a virtual branch experience powered by spatial computing technology. Customers can access virtual branches through their smartphones or VR headsets, allowing them to conduct banking transactions, seek assistance from virtual assistants, and explore financial products in an immersive environment. This initiative has enhanced customer engagement and accessibility while reducing the need for physical branch visits.

A large Indian software company has implemented AR-based maintenance solutions for the aerospace and defence industries, enhancing operational efficiency and customer satisfaction.

In healthcare, spatial computing and the metaverse are transforming patient care and medical training. A prominent healthcare provider in India, has adopted spatial computing technology to enhance surgical training programs. Surgeons undergoing training can practice complex surgical procedures in virtual reality simulations, replicating real-world operating room scenarios and patient conditions. These training simulations improve surgical skills, reduce the risk of errors, and enhance patient safety, leading to better healthcare outcomes. Meanwhile, an Indian multinational technology services company has created VR simulations for medical training, enabling doctors to enhance their skills and knowledge in a safe and immersive setting.

Automotive companies in India are using spatial computing to enhance vehicle design and manufacturing processes. One of the largest technology service providers in India has developed VR solutions for automotive design, enabling designers to visualise and modify vehicle designs in real time. A leading Indian automotive manufacturer has developed a virtual vehicle configurator powered by spatial computing technology. Customers can customise their vehicles in real time using a VR headset or a web-based application, selecting different colors, trims, and accessories to create their ideal car or SUV. This interactive configurator enhances the car-buying experience, streamlines the ordering process, and increases customer satisfaction.

A Virtual Reality startup and a Solar rooftop solutions provider collaborated to introduce innovative VR training for chemical handling. The collaboration aims to enhance safety and efficiency in chemical handling operations within the solar provider's manufacturing processes. By using virtual reality technology, employees undergo immersive and interactive training experiences, simulating various chemical handling scenarios in a safe virtual environment. The VR training program enables employees to familiarise themselves with protocols, procedures, and safety measures, improving their competency and readiness for real-world situations. This collaboration underscores a commitment to using advanced technologies to enhance employee training and ensure best practices in chemical handling operations.

An Indian IT services and consulting company has launched its Metaverse practice with the aim of providing interactive and immersive experiences for its customers. It intends to build B2B use cases across various sectors, including a metaverse-based car dealership, an NFT marketplace, a virtual bank and a gaming center). Additionally, it offers exclusive digital collectibles based on iconic brands on its NFT marketplace platform.

The table below showcases use cases across sectors in India:

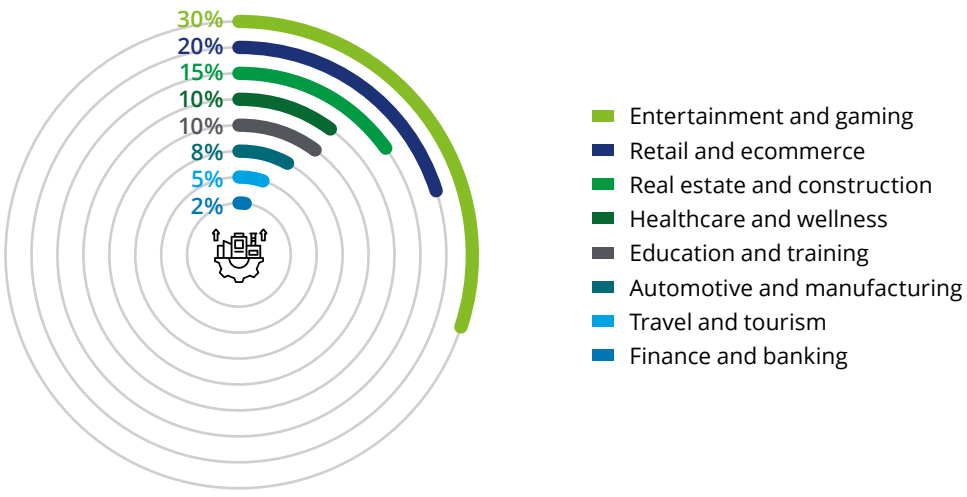
Sector	Function	Use case	Outcome/Impact
Retail	Customer experience	1. A leading global IT services company headquartered in Bengaluru has developed virtual showrooms that allow retailers to showcase products and engage with customers virtually. 2. A leading Indian hypermarket chain has integrated AR technology into its catalog app, offering customers an interactive shopping experience. Users can scan product images using their smartphones to view 3D models, product information, and reviews overlaid onto their real-world surroundings.	These use cases enhance customer engagement, leading to increased brand loyalty and higher sales conversion rates. They also enable retailers to personalise the shopping journey, improving customer satisfaction and driving repeat purchases. Additionally, AR/VR reduce the need for physical store visits, offering convenience and accessibility to a wider audience.
Manufacturing	Production processes	An Indian multinational conglomerate has deployed AR and VR technologies for building information modeling (BIM), allowing engineers and construction workers to visualise and interact with 3D models in real-world environments.	An Indian multinational conglomerate's adoption of AR/VR for BIM revolutionises construction, enabling immersive 3D model visualisation and interaction and improving collaboration, efficiency, and safety. This transformation optimises project outcomes, reduces errors, and enhances cost-effectiveness in construction processes.
Education	Online tutoring	One of the key Indian IT services and consulting companies has developed VR solutions for education, enabling students to participate in virtual classrooms and immersive learning environments.	This immersive learning experience enhances student engagement, improves knowledge retention, and expands access to quality education, particularly in remote or underserved areas.
Telecom	Corporate events	A leading telecommunications company in India hosted its annual general meeting (AGM) in the metaverse.	Using spatial computing platforms, shareholders and stakeholders participated in the AGM virtually, interacting with executives and experiencing product announcements in immersive environments.
Hospitality	Guest engagement	India's largest hospitality chain implemented virtual hotel tours using spatial computing technology.	Prospective guests can explore hotel rooms, facilities, and amenities in immersive 3D environments before making reservations. This virtual experience enhances transparency and trust, leading to increased bookings and customer satisfaction.
Entertainment	Customer engagement	India's leading online entertainment ticketing platform has introduced virtual concert experiences powered by spatial computing technology. Music enthusiasts can attend live concerts and performances in virtual venues, interacting with artists and fellow fans in real time.	This innovative approach to live entertainment expands access to cultural events and fosters community engagement.

Sector	Function	Use case	Outcome/Impact
Real estate	Customer experience	One of India's largest real estate advisory firms has integrated virtual property tours into its platform using spatial computing technology. Homebuyers can explore residential properties, commercial spaces, and development projects in immersive virtual tours, providing a realistic sense of space and layout.	This virtual viewing experience accelerates the property search process and facilitates remote transactions.
Tourism	Promotions	An Indian state tourism board has launched virtual tourist attractions using spatial computing technology. Travelers can explore popular destinations, cultural landmarks, and natural wonders in virtual reality, experiencing the beauty and diversity of the state from anywhere in the world.	This immersive virtual tourism initiative promotes destination awareness and encourages future travel planning.
Culture	Experience	One of the holiest sites in India, has introduced a VR darshan experience for devotees. Using the spatial computing technology, devotees can take a virtual tour of the temple, offering prayers and experiencing rituals from the comfort of their homes.	This initiative has enhanced accessibility and inclusivity, allowing devotees from around the world to connect with the divine.

As user organisations gear up for spatial computing and the metaverse, they must adapt their operations and services to fully embrace its transformative potential. From businesses exploring virtual storefronts to educational institutions redesigning learning experiences, the implications are vast. Yet, challenges abound, including training staff on new technologies and ensuring robust security measures. User organisations can mitigate these risks through strategic investments in employee training, tailored solutions in collaboration with technology providers, and stringent cybersecurity protocols.

In tandem, regulators navigate the complex terrain of metaverse governance, tasked with balancing innovation and consumer protection. The regulatory landscape must evolve to address emerging issues, such as data privacy, intellectual property rights, and digital taxation. To tackle these challenges effectively, regulators engage in dialogue with industry stakeholders, fostering flexible frameworks that foster innovation while safeguarding user interests. Proactive measures, including ongoing monitoring and periodic updates to regulatory frameworks, are essential to ensuring a harmonious and equitable transition to the metaverse.

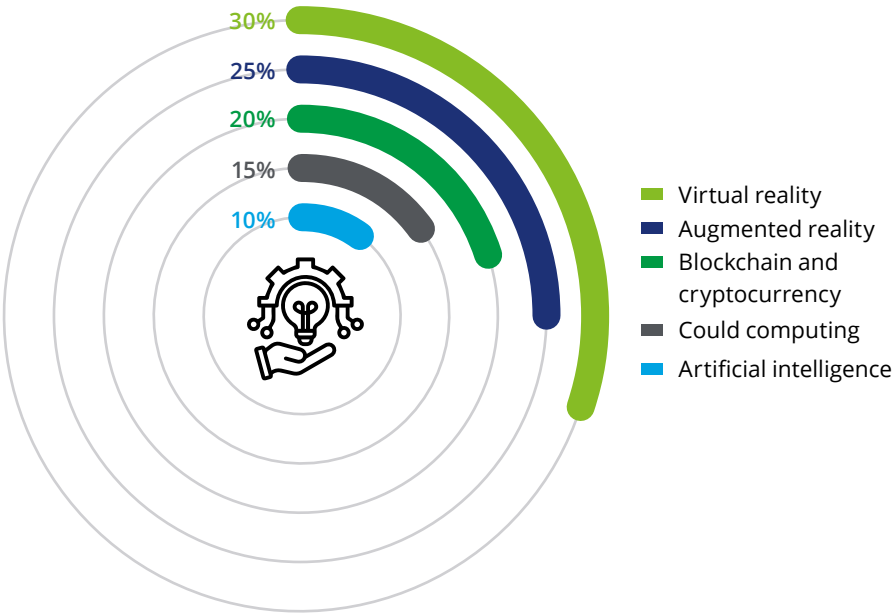
Figure 1: Metaverse adoption by industry[3]



[3] https://www.imarcgroup.com/india-metaverse-market

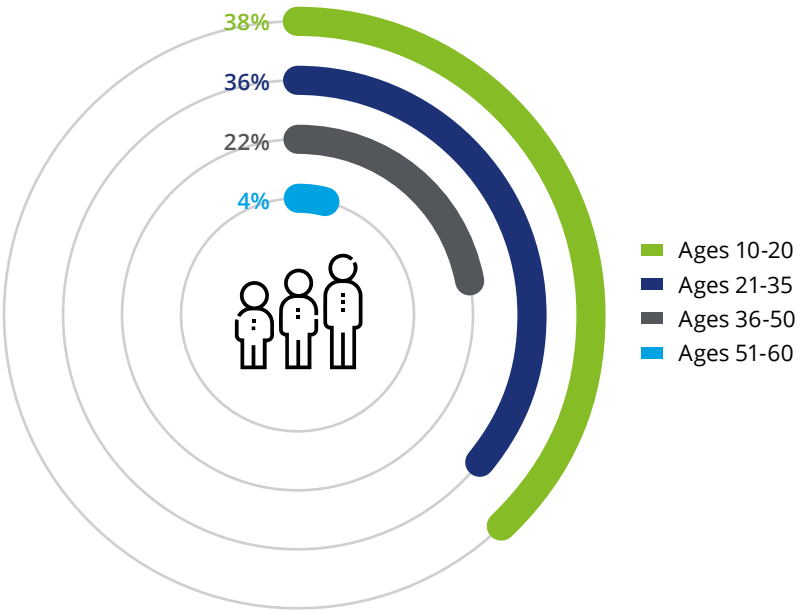
The metaverse tech stack, encompassing virtual reality (VR), augmented reality (AR), blockchain, artificial intelligence (AI), and cloud computing, holds significant potential for transforming industries across India. From revolutionizing customer experiences in sectors like real estate, tourism, and entertainment through immersive VR and AR applications to enhancing operational efficiency in manufacturing and urban planning with 3D modeling and IoT integration, the metaverse presents a wide array of opportunities. Blockchain ensures secure transactions and ownership verification, while AI powers virtual assistants and personalized experiences. With the adoption of cloud infrastructure, Indian industries can leverage the metaverse to drive innovation, collaboration, and growth in the digital economy.

Figure 2: Breakdown of the Metaverse technology stack[4]



In addition, the adoption of the metaverse varies across age groups, presenting challenges linked to digital literacy, cultural perceptions, economic disparities, and language accessibility. While younger demographics often embrace new technologies readily, older generations may face barriers due to limited digital skills, traditional values, and concerns about privacy and security. Economic factors, including the affordability of devices and internet access, further exacerbate disparities in adoption rates, particularly among older individuals in rural areas. Language barriers also contribute to exclusivity, necessitating efforts to enhance digital literacy, provide affordable access to technology, address cultural perceptions, and develop content in regional languages to promote more inclusive metaverse participation across all age groups in India.

Figure 3: Metaverse adoption by age[5]



[4] https://www.blueweaveconsulting.com/report/india-metaverse-market
[5] https://www.demandsage.com/metaverse-statistics/

Trend 2: Genie out of the bottle: Generative AI as a growth catalyst

The rise of GenAI calls for responsible adoption and robust governance frameworks to ensure alignment with ethical principles and societal values while maximising positive societal impact and sustainable development.

Since 2022, GenAI has transitioned from a topic of concern regarding job displacement to being recognised as essential for organisational competitiveness. AI's role has evolved beyond mere chatbots on websites; it can now undertake complex responsibilities as a co-pilot and auto-pilot for intelligent automation and decision-making processes. GenAI presents organisations with a unique opportunity to modernise and optimise their infrastructure architecture without embarking on extensive transformation projects. Its applications span various sectors in India, and the Indian GenAI landscape has numerous start-ups with substantial funding, indicating their growth potential. The period of 2023–24 witnessed a significant uptick in AI-related initiatives, with extensive workforce training underway.

GenAI holds immense market potential due to its versatility and transformative capabilities across industries. Its ability to automate tasks, personalise experiences, create novel content, and make complex decisions has positioned it as a key driver of innovation and efficiency. As technological advancements continue to accelerate and investments pour into GenAI R&D, the market is poised for substantial growth, offering opportunities for businesses to optimise processes, drive revenues, and deliver value to customers.

Organisations recognise GenAI's potential to revolutionise their operations, from personalised customer interactions to predictive analytics and automation of routine tasks. Furthermore, the accessibility of advanced machine learning algorithms, large language models (LLM), and the availability of vast amounts of data fuel the development and adoption of GenAI solutions. With a key focus on innovation and harnessing the power of data, businesses are using GenAI to unlock new opportunities, drive growth, and stay ahead in an increasingly digital world. The Ministry of Electronics and Information Technology (MeitY) has recently asked social media and AI platforms in India to seek permission before launching AI products.[1] This regulatory oversight is essential to addressing concerns related to data privacy, bias mitigation, and societal impact and fostering trust and accountability in AI technologies. Moreover, government funding initiatives are driving the GenAI market, particularly through public-private partnerships (PPPs). These collaborations utilise government resources and expertise alongside private sector innovation to accelerate AI research, development, and implementation. Government funding not only supports R&D efforts but also facilitates the adoption of AI technologies in critical sectors such as healthcare, agriculture, and education, driving inclusive progress and societal benefits. By fostering a conducive regulatory environment and providing financial support, governments play a pivotal role in unlocking the full potential of GenAI and ensuring its responsible and sustainable integration into society.

Organisations across sectors such as healthcare, retail, education, and agriculture are increasingly adopting GenAI to streamline operations, enhance customer experiences, and gain a competitive edge in the market.

India came up with its very own GPT-4-based GenAI tool that can answer questions related to the Bhagavad Gita. Spearheaded by MeitY, it seeks to address the country's reliance on foreign AI models and develop indigenous capabilities in AI R&D. By fostering collaboration between academia, industries, and government agencies, India aims to build a robust AI ecosystem and establish itself as a global leader in AI innovation.

[1] https://www.business-standard.com/india-news/meity-asks-intermediaries-ai-platforms-to-follow-it-rules-issues-advisory-124030200492_1.html

In another use case, a research team from India has teamed up with a leading cloud service provider and one of the largest technology service providers in India to use GenAI technology. Their goal is to develop mobile assistants capable of providing information on government schemes in multiple languages. It utilises language models from AI4Bharat and employs third party AI service for this purpose.

In healthcare, an Indian multinational healthcare group headquartered in Chennai and a leading cloud service provider have collaborated to provide healthcare services powered by advanced AI technology. Through the collaboration, the companies aim to combat misinformation by ensuring that authoritative and authentic health-related information is readily available in search results. Moreover, the healthcare group has developed the predictive cardiac risk score, AICVD, which is entirely based on data from the Indian population. The score predicts the future risk of cardiac disease and offers an opportunity to mitigate the risk through measures monitored by clinicians. Presently, over one million preventive health checks rely on this algorithm. Additionally, they provide a significant offering in the metaverse lineup that serves as a vital bridge between real-world clinical health data and virtual reality. It provides an immersive experience that allows individuals to observe their heart's health and wellbeing vividly, empowering them to take proactive measures.

In the retail sector, GenAI is revolutionising the shopping experience on ecommerce platforms.

In the B2C realm, GenAI is transforming the retail sector by enhancing the shopping experience for consumers. One of India's fashion e-commerce companies has launched virtual assistants to cater to individual preferences, offering tailored suggestions and collections. Another fashion e-commerce company introduced a virtual shopping assistant, assisting users throughout their shopping journey. Another company uses AI-powered translation tools to ensure a seamless experience for diverse consumers, while another AI tool streamlines seller tasks, reducing workload and improving efficiency.

On the B2B side, Generative AI is empowering retailers with advanced tools and capabilities to optimise operations and enhance seller support. AI-based platforms provide customised assistance to sellers, streamlining processes such as registration, listing, and advertising. This automation reduces manual workload and increases efficiency, enabling sellers to attend to growing their businesses effectively.

Sector	Function	Use case	Outcome/Impact
Education	Personalised evaluation	A Noida-based ed-tech start-up uses GenAI to personalise learning experiences for students and educators. The platform uses machine learning algorithms to analyse student performance data, identify learning gaps, and recommend customised learning paths tailored to individual needs and preferences.	By providing personalised feedback, adaptive assessments, and interactive content, it enhances student engagement, improves learning outcomes, and empowers educators to deliver more effective and impactful teaching experiences.
Agriculture	Monitoring crop health and yield	A Bengaluru-based agri-tech start-up, harnesses GenAI to empower farmers and agribusinesses with data-driven insights and solutions. The platform integrates satellite imagery, weather data, soil sensors, and other IoT devices to monitor crop health, predict yield, and optimise farming practices.	By leveraging GenAI algorithms, it provides actionable recommendations to farmers regarding irrigation scheduling, fertiliser application, and pest management, thereby improving crop yields, reducing input costs, and promoting sustainable farming practices.
Human Resources	Talent acquisition and employee engagement	HR companies are using GenAI to streamline HR processes such as candidate screening, talent acquisition, employee engagement, and training.	GenAI is facilitating automation and optimisation of various HR tasks, resulting in improved productivity and cost savings for companies.
Technology	Engineering	A leading Modernisation Engineering company in India is leveraging cloud infrastructure and AI services to develop and deploy GenAI solutions for its clients. The partnership aims to accelerate the adoption of GenAI technologies across various industries, enabling organisations to utilise AI-driven insights for business transformation.	The collaboration empowers developers to accelerate the creation of industry-specific applications while adhering to the highest ethical standards.

Sector	Function	Use case	Outcome/Impact
Banking	Operations	India's leading banks are increasingly adopting private language model (LLM) solutions to enhance operational efficiency and improve customer experience. These private LLMs are trained on proprietary data and customised to meet the specific needs of banks, allowing them to analyze vast amounts of customer data, automate processes, and provide personalised services.	By leveraging private LLMs, banks can streamline operations, reduce costs, and deliver more relevant and efficient services to their customers.

From a cybersecurity standpoint, GenAI can be used to address cybersecurity challenges and opportunities. There is an urgent need for organisations to embrace GenAI to enhance cybersecurity capabilities, mitigate risks, and protect against emerging threats. GenAI can be used for various applications, such as threat detection, incident response, and vulnerability management. At the same time, enterprise usage of GenAI must consider mitigation strategies pertaining to cyber risks. Technologists planning on a GenAI strategy and roadmap must work collaboratively with cybersecurity experts right from the onset to identify and mitigate security risks.[2]

The Indian GenAI landscape has over 70 start-ups [6] dedicated to offering solutions and services to their customers across various industry verticals. More than US$590 million in funding has already flown into this space; however, there is still room for more investment in GenAI business infrastructure. Even as profitability and growth potential are recognised by investors, part of the hesitation to back expensive infrastructure ventures could be attributed to the fact that the Indian government still needs to provide a more welcoming regulatory framework for AI and ML research and development.

The period 2023–24 has emerged as a pivotal time for AI in India, showcasing the country's ability to harness this revolutionary technology for societal benefit and inclusive progress. Indian companies are diversifying their services by integrating AI-driven analytics, leading to a remarkable 2.7X growth in AI-related initiatives compared with the previous year. Notably, between 2023 and 2024, more than 6.5 lakh employees are expected to undergo training in GenAI skills, reflecting a concerted effort to equip the workforce with the necessary capabilities for the AI-driven future. The GenAI market is expected to witness significant growth in the coming years, with an expected CAGR of over 24.4 percent from 2023 to 2030. In 2029–30, India could see a significant boost to its GDP, ranging from US$359 billion to US$438 billion, through the adoption of GenAI, surpassing baseline estimates.

Having said that, in deploying GenAI within organisational settings, cybersecurity and risk considerations assume critical importance. There must be robust encryption and access controls to mitigate the risk of unauthorised access or breaches. Maintaining the integrity of GenAI models is vital for preventing adversarial attacks and ensuring the reliability of AI-generated outputs. Organisations must also remain vigilant against emerging cybersecurity threats targeting GenAI systems, necessitating the implementation of real-time threat detection mechanisms. Compliance with regulatory frameworks and industry standards is imperative, requiring adherence to data protection regulations and AI governance guidelines. Investing in employee training and awareness programmes is essential for fostering a culture of cybersecurity consciousness. Proactively addressing these cybersecurity and risk considerations is paramount to harnessing the benefits of GenAI while safeguarding against potential vulnerabilities.

In addition, responsible adoption of AI is paramount to ensuring that the integration and utilisation of AI technologies align with ethical principles, societal values, and legal frameworks. In India, where the adoption of AI is rapidly accelerating across various sectors, it is imperative to establish robust guidelines, standards, and governance frameworks to govern the development, deployment, and use of AI systems. This entails promoting awareness and understanding of ethical AI principles among policymakers, industry stakeholders, and the public, and fostering collaboration and dialogue to address the ethical, legal, and societal implications of AI technologies. By embracing responsible AI adoption, India can harness the transformative potential of AI while safeguarding against potential risks and ensuring that AI technologies contribute to positive social impact and sustainable development.

[2] https://nasscom.in/knowledge-center/publications/generative-ai-startup-landscape-india-2023-perspective

Figure 4: Likeliness of trusting an AI-based business[3]

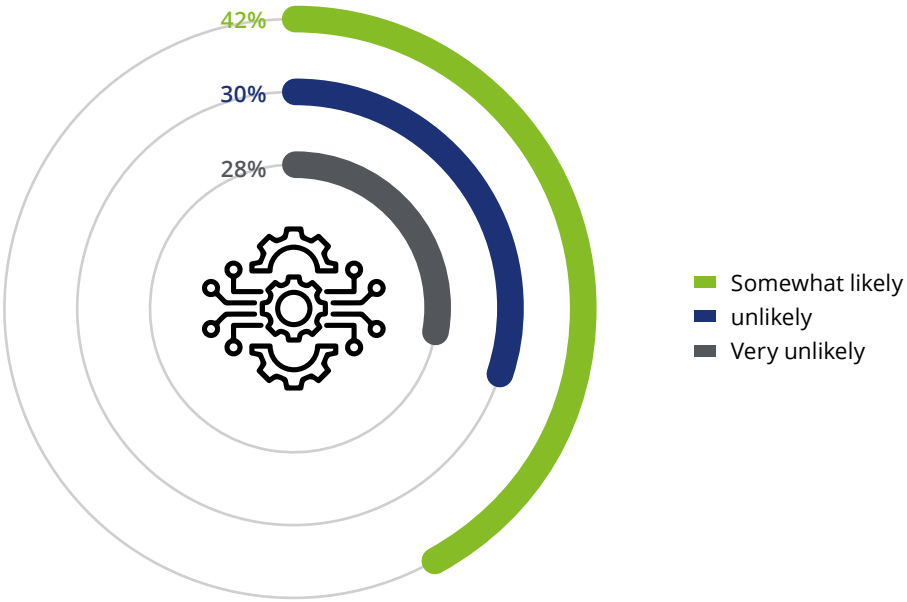
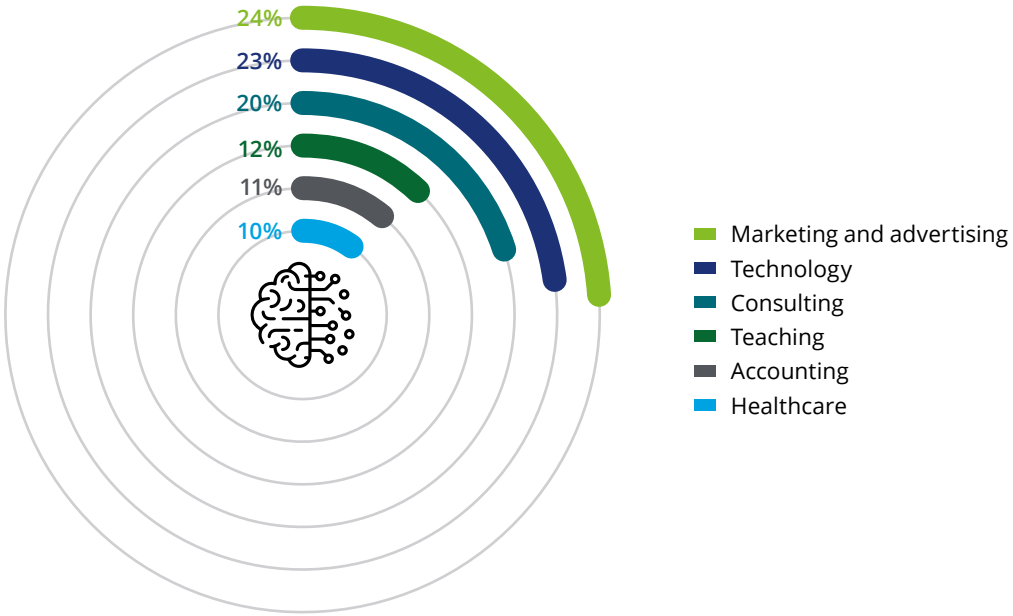


Figure 5: Estimated GenAI adoption by Indian companies across industries[4]



[3] https://www.tidio.com/blog/ai-statistics/

[4] https://www.suntecindia.com/blog/generative-ai-adoption-by-industries-trends-and-statistics/

Trend 3: Smarter, not harder: Beyond brute force compute

While traditional computing hardware struggles with ever-increasing data demands, there is a rising computing revolution, powered by technological advancements in cloud computing, supercomputers, and quantum computers.

Organisations are increasingly becoming data-driven and pushing growing demand for computational power. The past few decades have witnessed exponential growth in the IT sector, fueled by CPUs and GPUs. However, traditional hardware limitations are starting to emerge. With chip manufacturers reaching the peak of how much processing power they can physically cram into CPUs, a turning point for computation is just around the corner.

The demand for computational resources is only increasing, and with hardware specifications maxing out, the new era of computing will be brought about not by trying to overcome the physical constraints of the hardware, but by smarter optimisation of the codebase running on the hardware. The advent of GenAI, capable of creating never-before-seen content, throws another challenge at moving beyond brute force compute.

Shift towards software optimisation

Code optimisation: Smart optimisation of codebase to get the most out of the hardware infrastructure. AI co-pilots and startup code generators are disrupting and augmenting tech services, freeing up developers to direct their attention to solving more complex problems. The emergence of open-source and low-/no-code platforms delivering community-driven, user-friendly development environments. By leveraging cloud-native architecture – microservices, containers, serverless, and refactoring applications to the cloud – organisations can unlock significant software optimisation.

Parallel processing: The parallel processing capabilities of GPUs have made them the preferred hardware for training AI models due to their efficiency. They allow significant speed of function over traditional CPUs. Most leading global chip manufacturers offer GPU products.

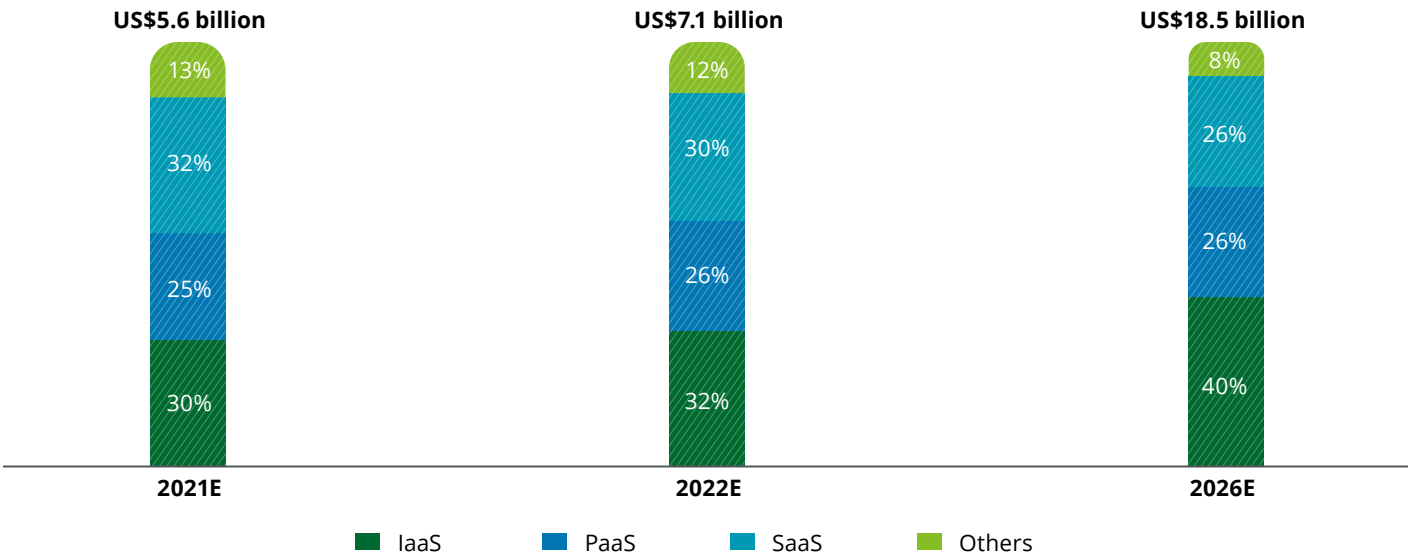
Technology advancements

More processing power is needed to unlock the full potential of digital transformation. As the demand for computational power continues to rise, India is strategically positioning itself as a leader in exploring new solutions and fostering innovation in the fields of cloud computing, quantum computing, and AI supercomputing.

- **Cloud computing:** With businesses increasingly adopting hyperscale solutions, the Indian hyperscale market is expected to reach US$10 billion by 2028.[1] According to a report by Oliver Wyman and NASSCOM,[2] cloud technology will likely account for 8 percent of India's GDP by 2026. It has the potential to boost the country's GDP by US$310–380 billion by 2026 and create 14 million jobs. A concentrated all-around effort can result in a continuous 25–30 percent growth in cloud investment over the next five years to reach US$18.5 billion, assisting India in realising the full potential of the cloud market. This growth is fueled by factors such as 5G penetration, rising cloud computing demand, and government regulations that favour India as a hub for both international and domestic hyperscale players.

Focus on application development, automation, verticalised products, SaaS, data migration for AI, and cloud enterprise spending are some of the notable drivers of the growth of India's cloud computing consumption.

Figure 6: Public cloud spending in India



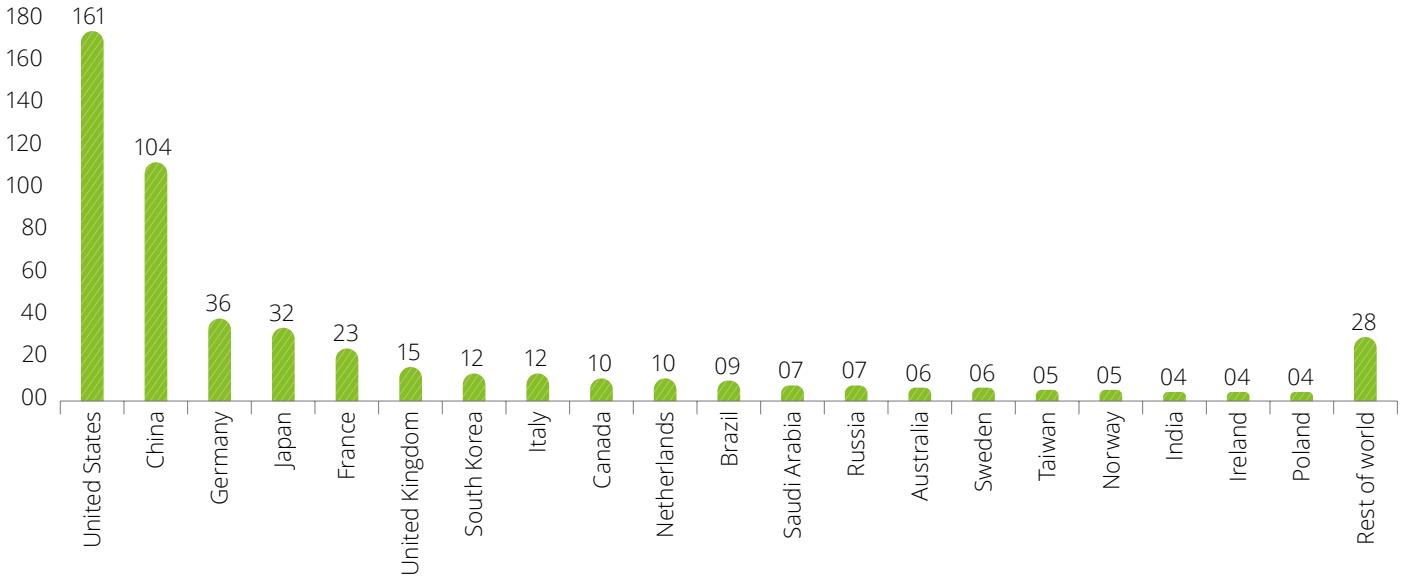
Source: NASSCOM Future of Cloud Report[2]

[1] https://www.statista.com/outlook/tmo/data-center/india

[2] https://www.oliverwyman.com/our-expertise/insights/2022/sep/future-of-cloud-and-its-economic-impact.html

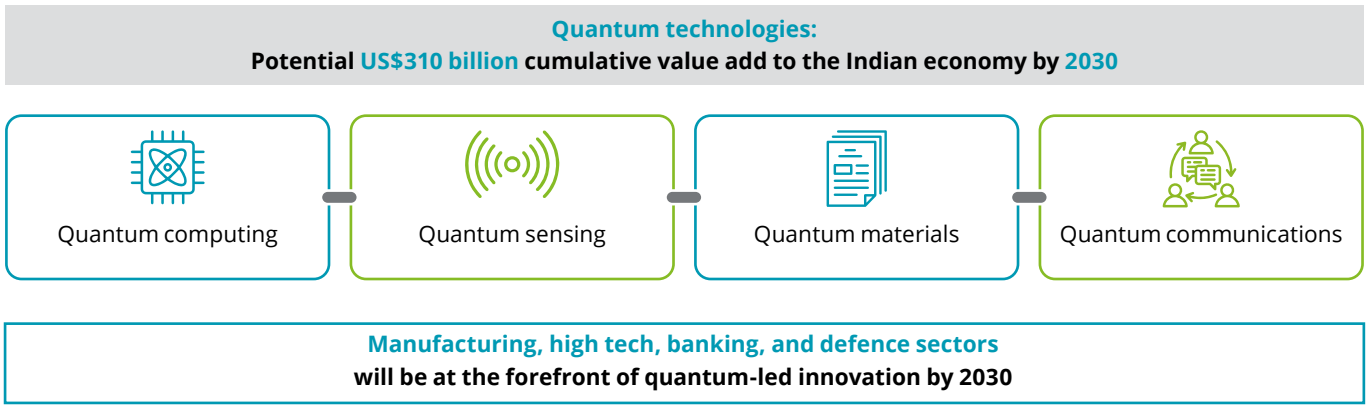
- **AI supercomputing:** AI supercomputing involves using machine learning and deep learning to process trillions of computations per second to achieve tremendous insights. Organisations use ultrafast processors made up of hundreds of thousands of powerful machines to manage and interpret vast quantities of data using AI models. The US and China are leading the supercomputer market.[3] Of the top 500 supercomputers globally, India has four – AIRAWAT – PSAI, PARAM Siddhi-AI, Pratyush, Mihir. These are managed by Center for Development of Advanced Computing (C-DAC), Indian Institute of Tropical Meteorology, and the National Centre for Medium Range Weather Forecasting.[3]

Figure 7: Distribution of the 500 most powerful supercomputers worldwide 2023, by country



Source: Top500.org

- **Quantum computing:** Classical computers perform computations using algorithms based on binary logic gates. Quantum computers utilise quantum gates, which operate on quantum bits (qubits) and can perform massive parallel processing, enabling faster solutions. Recognising its potential in areas such as defence and cybersecurity, the Indian government is actively promoting quantum-based projects.[4]



[3] https://www.top500.org/lists/top500/2023/11/

[4] https://nasscom.in/knowledge-center/publications/quantum-revolution-india-betting-big-quantum-supremacy?check_logged_in=1

Favourable government programmes

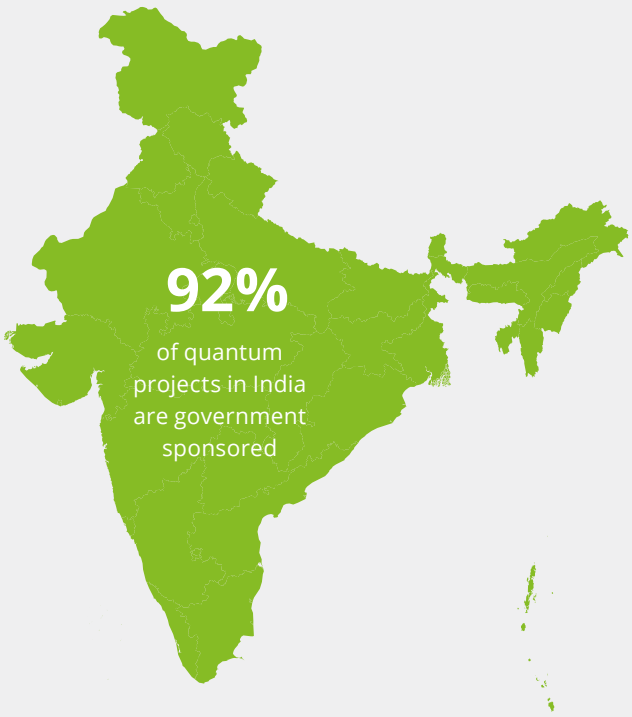
India is actively contributing to the advancement of computing power and has explicitly identified quantum computing as an area for international collaboration and knowledge sharing. The economic potential of quantum computing and its impact on global digital economies makes it crucial in terms of geopolitical strategies. Hence, India is focusing on how quantum computing can be applied in our business and governance models.

The Ministry of Electronics and IT in India is sponsoring ~92 percent of the ongoing quantum initiatives. While enterprise adoption of quantum computing technology currently stands at ~12 percent, it is estimated to reach ~35–45 percent over the next decade, bringing in an estimated US$280–310 billion to the economy.

- **National Quantum Mission:** On 19 April 2023, the Indian federal government approved US$730 million in funding for the country's inaugural National Quantum Mission (NQM). The project aims to deliver intermediate-scale quantum computers with 50–1,000 physical qubits by 2031 and make India one of the leading countries in the development of Quantum Technologies & Applications (QTA).[4]
- **Quantum Computing Applications Lab (QCAL):** MeitY has collaborated with a leading cloud service provider to set up a quantum computing lab. The initiative provides researchers and developers in India with access to a cloud-based quantum computing development environment. It is also the first of its kind to support a government science and technology mission at a national level.[4]
- **IndiaAI Mission:** This government-backed initiative aims to foster AI development in India. The cabinet has approved the India AI Mission with an outlay of INR 10,372 crore for five years to encourage AI development in the country. Under the mission, a supercomputing capacity comprising over 10,000 GPUs will be made available to various stakeholders, promoting the creation of a robust AI ecosystem.[4]
- **India Digital Public Infrastructure (DPI):** India's DPI has gained global recognition, previously recognised as the India Stack. Successfully showcased during India's G20 presidency, it is now considered a model for other countries to emulate. The DPI, which includes the Aadhaar digital identity established in 2009, along with subsequent services such as the Unified Payments Interface (UPI), the JAM (Jan Dhan Yojana, Aadhaar, and Mobile number) trinity, Co-WIN (for managing the COVID-19 vaccination programme), Digilocker, and Ayushman Bharat Digital Mission, among others. It is built on foundational principles of open APIs, interoperability, privacy by design, inclusive design, and universal access. The DPI has played a pivotal role in India achieving 80 percent financial inclusion within a span of just six years.[5]

  The success of India's DPI is evident from the eight MoUs signed with other countries. Armenia, Sierra Leone, Suriname, Antigua, Barbados, Trinidad and Tobago, Papua New Guinea, and Mauritius have entered into agreements enabling them to access India's DPI at no expense and with open-source accessibility. These countries are now empowered to harness these resources to cultivate their distinct innovations. They can now use these resources for the development of their distinctive innovations.
- **International partnerships:** India has invested in extensive strategic collaborations, enlisting the help of nations around the world to expand its capabilities.
  - **Quantum computing:** US-India Initiative for Critical Emerging Technologies, and the EU-India Trade and Technology Council, Singapore, Finland.
  - **Semiconductors Supply Chain Innovation and Partnership:** Japan-India Memorandum of Cooperation, India and the US MoU, EU and India MoU.

Figure 8: Quantum projects in India



[5] https://www.businesstoday.in/magazine/deep-dive/story/heres-how-indias-digital-public-infrastructure-is-going-global-405177-2023-11-09

India's move beyond binary computing

India is charting a pioneering path beyond binary computing, ushering in a new era of technological innovation. The move reflects India's commitment to pushing the boundaries of computing, positioning the country as a global player in advanced information processing. It signifies the journey to become a formidable player in the global landscape of cutting-edge computing.

India's AI supercomputer, AIRAWAT, currently ranks 90th in the world overall, positioning India in the field of AI supercomputing.[3] This is in line with the Indian government's "AI FOR ALL" vision. This aims to aid in the fields of applied AI, natural language processing, image processing, pattern recognition, agriculture, medical imaging, education, healthcare, audio assistance, robotics, and developing solutions for strategic sectors.

The Indian government aims to increase focus on citizen governance using GI Cloud (MeghRaj), which enables ease and provides authentic access and transparency to government benefits for common citizens because of cloud computing.

The focus of this initiative is to accelerate the delivery of e-services in the country while optimising ICT spending by the government. This will ensure optimum utilisation of the infrastructure and speed up the development and deployment of eGov applications.

One of the largest software providers in India has signed an MoU with the Centre for Development of Advanced Computing (C-DAC) to collaborate on the creation of a joint working group to accelerate High Performance Computing (HPC) in India. The collaboration intends to spur and support the growth of India's developer community, with a focus on processor design, system design, firmware, and application development, including contributions to open-source initiatives.

India's first quantum computing-based telecom network link has been established between Sanchar Bhavan and the National Informatics Centre in New Delhi.

In the global arena, a large American semiconductor chip provider dominates the next-GenAI computing markets. It is projected to earn a whopping US$130 billion by 2026.[6] India,

[6] https://wccftech.com/nvidia-estimated-to-earn-a-whopping-130-billion-in-revenue-by-2026-courtesy-of-ai/#:~:text=Videos%20How%20To-,NVIDIA%20Estimated%20To%20Earn%20a%20Whopping%20%24130%20Billion,By%202026%2C%20Courtesy%20of%20AI&text=NVIDIA%20looks%20all%20set%20to,five%20times%20higher%20than%20FY23.

propelled by its tech-savvy population, is experiencing a robust demand for semiconductor chips. Projections indicate that the country's chip market is set to reach an impressive US$55 billion by 2026, according to reports.[7]

According to the Deloitte Pre-Budget Survey 2024, government efforts, coupled with a stable policy framework, R&D incentives, and robust IPR frameworks, can boost growth in India's semiconductor industry. Several companies are setting up semiconductor manufacturing units in India.

- A leading Indian IT services company has collaborated with a Taiwanese semiconductor giant to establish a facility for testing and packing third party-designed semiconductors.
- The electronics wing of a large Indian multinational conglomerate has formed a partnership with a Taiwanese semiconductor manufacturing corporation to build India's first AI-enabled semiconductor fabrication facility.
- An American multinational technology company specializing in enterprise solutions announced plans to manufacture US$1 billion worth of high-runner servers from India over the next five years.
- An American multinational technology conglomerate plans to set up a manufacturing facility in India to diversify its global supply chain.

India is the leader in digital payments with Unified Payments Interface (UPI) payments. It is steadily becoming globally attractive amid measures to enable seamless cross-border transactions, reducing the cost of fund transfers and remittance payments. Overseas markets accepting UPI payments include:

- **Europe:** NPCI International Payments Limited (NIPL) has collaborated with European payment services facilitator, allowing merchants' Point-of-Sale (PoS) systems in Europe to accept UPI payments from Indians using their mobile phones.
- **France:** Enabling a seamless and convenient payment experience for Indian tourists, through a strategic collaboration with a French digital payment platform.
- **UK:** The UK's leading global payments infrastructure group, collaborated with NIPL to enable Indian customers and merchants with active UPI IDs to make and accept cross-border payments.
- **Oman:** An MoU between the Central Bank of Oman (CBO) and NIPL in October 2022 will enable Indian RuPay cards and the UPI platform in Oman to facilitate seamless digital remittances, which will benefit Indian workers and professionals.
- **Singapore:** The Reserve Bank of India (RBI) signed an agreement with the Monetary Authority of Singapore to implement interoperability between UPI and the fast payment system of Singapore.
- **Malaysia:** A leading Malaysian financial technology company collaborated with NIPL to allow sending remittances through UPI to India.

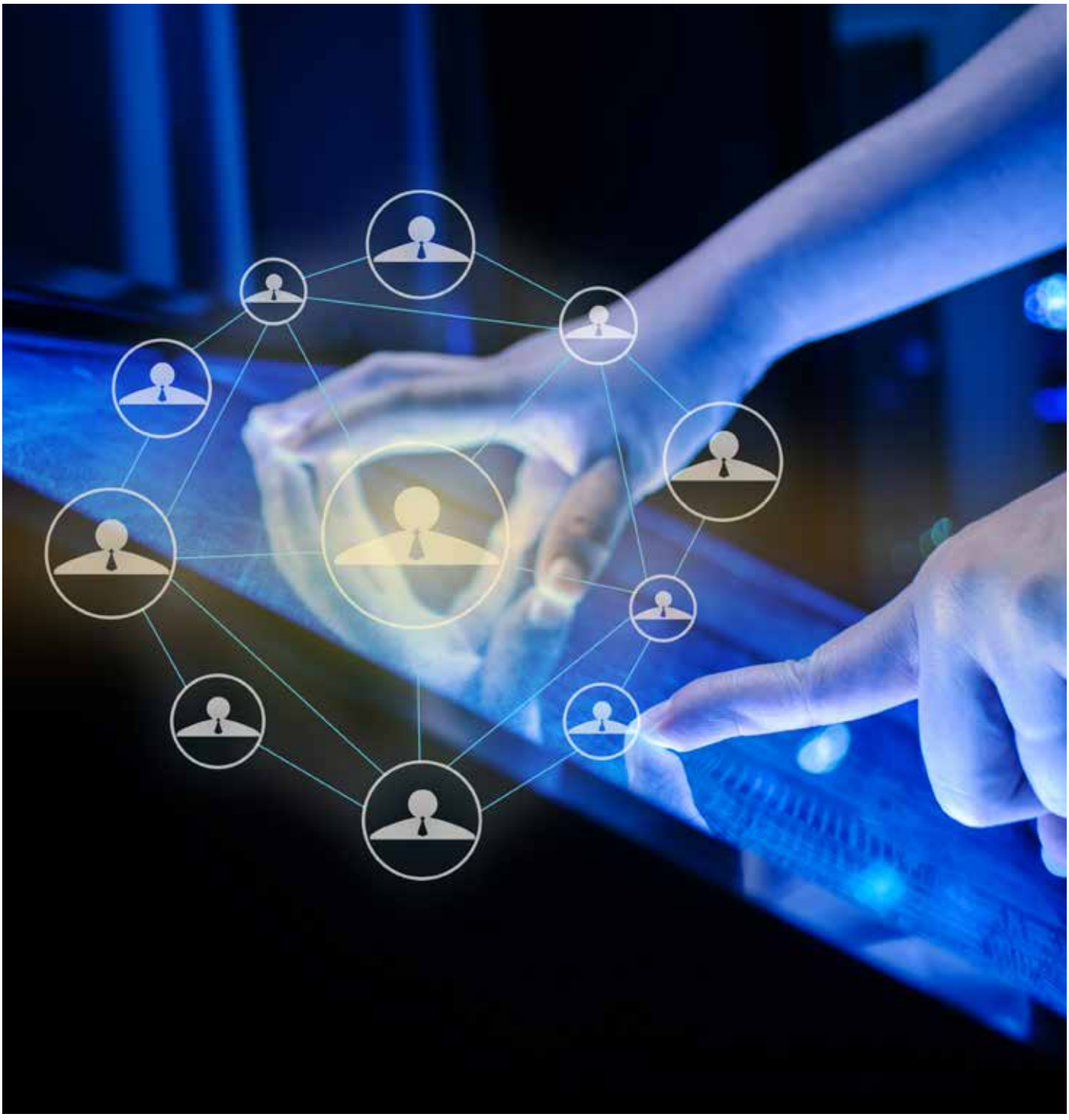
Indian Space Research Organisation (ISRO) has successfully demonstrated free-space quantum communication over 300 meters. This is a major breakthrough towards ISRO's goal of demonstrating Satellite Based Quantum Communication,where ISRO is gearing up to demonstrate the technology between two Indian ground stations. A large cloud service provider has collaborated with ISRO to advance India's space capabilities with cloud technologies - enable start-ups to develop space-tech solutions and strengthen R&D.

One of the largest technology service providers in India has been the tech backbone of the ATP (the men's tennis circuit), Grand Slam Australian and French Opens, and the International Tennis Hall of Fame, providing data and analytics support to marquee tennis tournaments since 2016.

This is just the beginning of India's exciting journey in the computational power domain. Government initiatives and private sector participation are propelling India towards becoming a major player in the global computing landscape.

[7] https://auto.economictimes.indiatimes.com/news/auto-components/indian-semiconductor-market-to-reach-usd-55-billion-by-2026-deloitte/98291901#:~:text=2%20min%20read-,Indian%20semiconductor%20market%20to%20reach%20USD%2055%20billion%20by%202026,and%20computing%20and%20data%20storage.

Tech trends for 2024
Grounding forces



Trend 4: From DevOps to DevEx: Empowering the engineering experience

Attract, retain, and empower top tech talent to drive innovation and collaboration, propelling India to shine bright in the global tech landscape.

India has the largest reserve of young and skilled tech talent, with an estimated 18 million STEM graduates by 2027. A strong IT and engineering workforce of 2 million professionals currently based in India's top 15 Tier-2 cities, indicates a tech-led transformation for the country. Thriving in India's dynamic tech ecosystem depends on the ability to attract and retain top-tier tech talent.

However, challenges such as limited growth prospects, achieving a balance in work-life dynamics, or inadequate tools could contribute to substantial employee turnover, thereby incurring costs for companies in terms of recruitment, onboarding, and productivity loss.

Per the Deloitte India Talent Outlook 2023 survey,[1] average India increments will drop to 9.1 percent in 2023 from 9.4 percent in 2022. Attrition levels across India Inc. were 17 percent in 2023, on the back of a subdued job market, macroeconomic headwinds, layoffs across sectors, and an uncertain future environment. With demand for technology talent coming down on account of both a slowdown in customer markets (for IT services companies) in North America/Europe as well as lesser funding available for early-stage companies, the need to hire more people has declined and, with it, the large attrition numbers. Attrition for key talent continues to be a challenge for companies, ranging from 1.5X to 1.7X of total attrition.

In the quest for organisational excellence, prioritising the enhancement of Developer Experience (DevEx) emerges as a critical imperative. A few proven strategies to elevate DevEx are as follows:

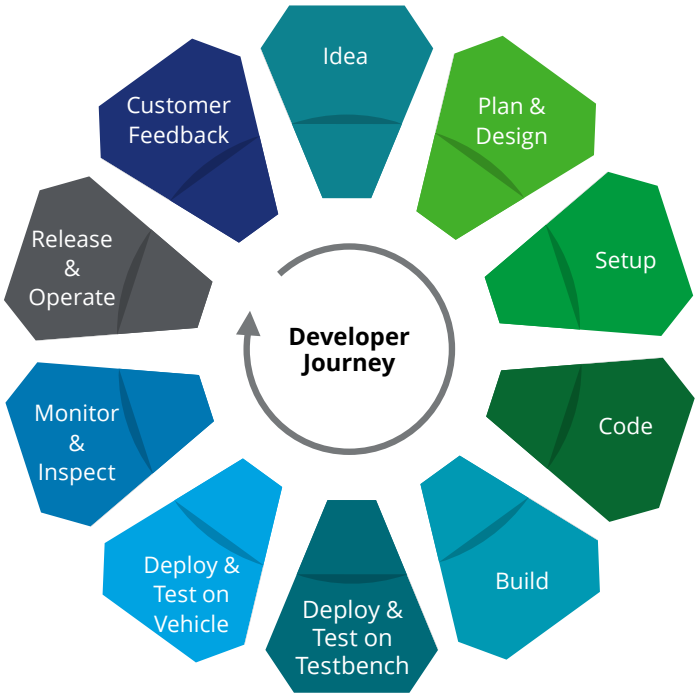
1. **Empower developers with right tools and accelerators**
   Empowering developers with the right tools and accelerators right from project initiation will foster an efficient delivery experience and minimise roadblocks. This helps in streamlining processes, identifying potential issues early, and predicting roadblocks before they happen.
   - Replace manual, repetitive, rule-based tasks with automation and ML.
   - Use of user-friendly, low-code platforms, and AI-based co-pilots helps simplify developer tasks.
   - Break down monolithic applications into smaller, modular microservices-based architecture.
   - Incorporate security by default, streamlining security and privacy through DevSecOps and privacy-by-design principles in development, allowing developers to focus on writing clean, secure code.

2. **Product thinking for technical products**
   - Apply product-thinking principles to technical products and platforms.
   - Incorporate product managers and UX designers into platform teams to ensure holistic understanding.
   - Accelerate development processes, reduce complexity, and enhance time-to-market through strategic application of product thinking.

3. **Understand developers' journeys**
   - Engage in the field to gain firsthand insights into developers' tasks and challenges.
   - Utilise techniques such as customer journeys and service blueprints to comprehensively map developers' experiences.
   - Identify various developer personas, their unique needs, and pain points to tailor solutions effectively.

[1] https://www2.deloitte.com/content/dam/Deloitte/in/Documents/about-deloitte/in-deloitte-india-talent-outlook-2023.pdf

Figure 9: Developer Journey



4. **Shorten feedback loops**
   - Implement agile and lean principles, encouraging work to be done in small, iterative batches.
   - Optimise feedback loops to provide faster and simpler responses, fostering a dynamic and responsive development environment.
   - Measure progress by focusing on frequent, impactful tasks within the developer journey to enhance efficiency.

5. **Enable collaboration**
   - Emphasise collaboration between different disciplines, creating a symbiotic relationship for mutual success.
   - Host joint activities such as lunch breaks, lightning talks, and hackathons to encourage cross-disciplinary interactions.
   - Open daily standups to enhance mutual understanding among teams, fostering a collaborative culture.

6. **Foster a culture of continuous learning and experimentation**

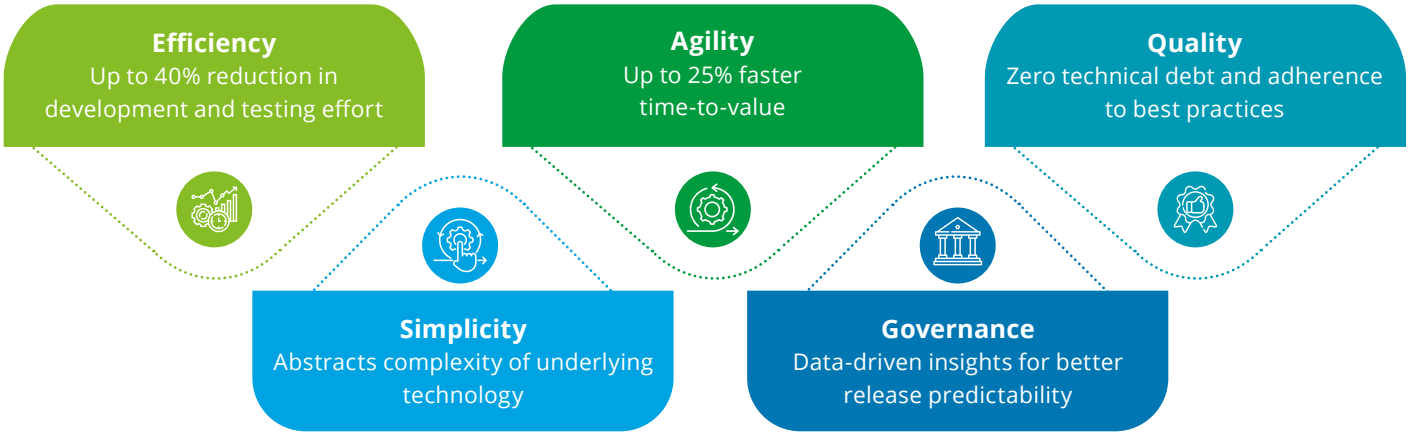
   Continuous learning, training, and building new and differential skillsets is crucial to maximising a developer's experience:
   - Create a healthy and safe environment for teams to experiment and innovate.
   - Evaluate organisational culture - focus on creating a culture that prioritises psychological safety.
   - Prioritise psychological safety to encourage experimentation, ultimately driving innovation and continuous improvement[1].

Companies that prioritise DevEx can cultivate a more engaging and satisfying workplace, ultimately reducing turnover and cutting costs. DevEx is not just about enhancing employee satisfaction; it is a strategic investment for companies and the country. By creating a positive DevEx environment, India can harness its vast developer talent, drive innovation, and achieve sustainable growth in the global tech landscape.

Examples of Developer Experience (DevEx) in action

One of the largest technology service providers in India has developed a Live Enterprise Application Development Platform that has revolutionised the application modernisation and development journey by offering a developer-centric experience. Tailored to overcome challenges associated with rigid legacy applications and intricate data architectures, this platform is dedicated to simplifying and expediting the entire application lifecycle. Drawing from insights gained through over 10,000 modernisation programmes for 600+ clients, it seamlessly integrates hyper-automation, ensuring adherence to established standards and best practices.

Figure 10: Outcomes of Live Application Development platform[2]



The platform provides developers with a cohesive experience across the UI, business layer, data, cloud services, and infrastructure. It enhances productivity and integrates smoothly with various GenAI tools. The platform's hyper-automation benefits are substantial, with up to a 40 percent reduction in development and testing effort, up to 25 percent faster time-to-value, and a commitment to zero technical debt and governance through data-driven insights. The guided AI-powered workflow spans the entire technology stack, covering architecture, development, testing, and deployment, ensuring a seamless developer journey. This effectively addresses challenges associated with high costs, extended time-to-value, standards enforcement, and complexity in modern architectures. It ensures real-time visibility into technical debt, provides data-driven manager dashboards for project health metrics, and aids in identifying focus areas for improving sprint velocity and release predictability. The platform aligns with the company's overarching goal of assisting businesses in "Navigating your next," with a focus on providing a developer experience that promotes innovation and efficiency.[2]

[2] https://www.infosys.com/services/application-modernisation/offerings/application-development-platform.html

Trend 5: Defending reality: Truth in an age of synthetic media

Navigating truth in a world of deepfakes, misinformation, phishing, and cyberattacks is challenging. With India's huge population and easy internet access, this increases multifold, but organisations are aggressively managing through a mix of security policies, regulations, and technologies.

2023 was the year of AI. GenAI is a subset of AI that employs deep learning and neural network techniques on massive-scale data to generate new content – text, images, video, audio, and code. The proliferation of GenAI tools has created a world-wide technological storm. Whether we are excited developers or businesses wanting a competitive edge, emerging technologies such as GenAI and quantum computing have unlocked a plethora of new possibilities.

However, misuse of these highly capable tools poses a significant risk to society, as they can be used to spread misinformation and even manipulate public opinion. Synthetic media, powered by AI, can create realistic yet fake content by manipulating audio, video, and text. Deepfakes, AI-generated morphed content, can spread misinformation and erode trust. It has become a significant concern. Synthetic media has the potential to violate Intellectual Property (IP) and copyright risks.

This is particularly concerning for India, where there is a lack of cybersecurity awareness and a limited public understanding of synthetic media threats, making individuals more susceptible to manipulation. With over 1.4 billion people (~50 percent internet penetration) and heading for a general election in April–May 2024, India ranked first in the potential risks of misinformation and disinformation per the World Economic Forum Executive Opinion Survey 2023.[1] Data privacy, security, copyright infringement concerns, and unprecedented cyber threats are among the biggest challenges faced by India today.

India is not new to the scare of misinformation. The governance is more challenging, just considering the sheer size and diversity of the Indian population. Deloitte's Cyber Insurance in India report identifies industries heavily involved in digitisation, such as IT, pharma, and manufacturing, as well as those integrated with broader economic sectors such as supply chain, retail, critical industries, and finance, as prime targets of cybercriminals.[2,3]

In 2019–2020, during the pandemic, COVID-19-related online fake news posed a huge threat to global public health. While social media was instrumental in providing a helping hand to those in distress, it was also the biggest producer of misinformation. The concern about the proliferation of misleading information, rumours and myths forced the government to institute various interventionist steps to stem their flow. The Indian government set up a "Mygov Corona" chatbot on a leading social networking chat company to provide coronavirus-related verified information to users. The bot was built by a private telecom giant, while the information is provided by the health ministry.

Scams: The common threat of Synthetic media for the aware and the unaware

In India, the digital landscape is marred by a staggering vulnerability to phishing attacks, with ~30 crore people susceptible to online threats. Among them, an alarming 5 lakh individuals fall prey to scamsters every year who exploit various tactics to deceive unsuspecting victims. The gravity of the

[1] https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2024.pdf

[2] https://www2.deloitte.com/in/en/pages/financial-services/articles/cyber-insurance-gains-momentum-in-India.html

[3] https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-cyber-insurance-in-India-noexp-final.pdf

situation becomes even more apparent when considering that, in 2023, the country witnessed a total rate of 129 cybercrimes per 1 lakh Indian citizens.[4]

The most prevalent scams reported paint a concerning picture of cyber threats. These scams include customer care number/KYC/refund scams, accounting for 35 percent of reported cases; sextortion at 24 percent; online booking/ fake franchisee/QR code scams at 22 percent; aadhar-enabled payment system scams at 11 percent; and Android mobile malware scams at 8 percent. This diverse range of fraudulent activities underscores the need for increased cybersecurity measures to protect citizens from falling victim to these malicious schemes.[5,6]

In response to rising cyber-enabled financial frauds, drawing attention to the pressing need for effective reporting mechanisms and intervention strategies, The National Cybercrime Helpline (1930) and The National Cybercrime Reporting Portal (NCRP) (which was launched in August 2019) have documented multiple cybercrime complaints. This shows the scale of the issue.[4]

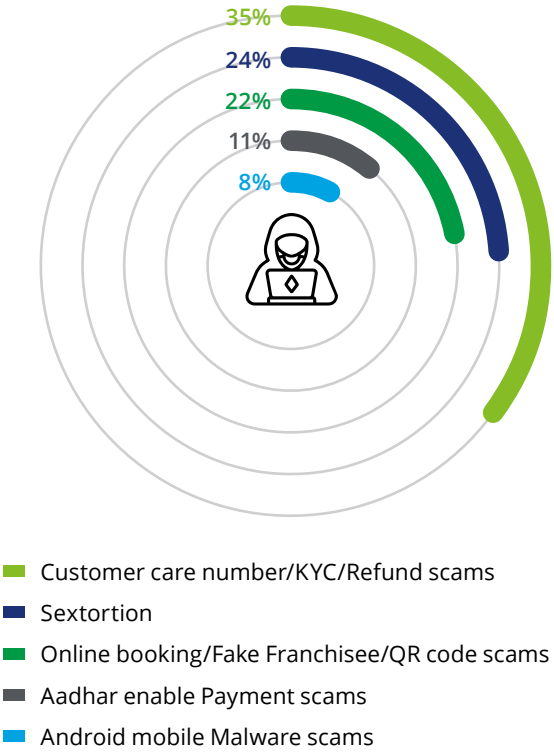
As the digital space becomes increasingly perilous, various scams targeting those seeking work-from-home opportunities have escalated. The Indian government's Cyber Cell has identified numerous fraudulent schemes, including data entry scams, online survey scams, freelance job scams, and investment scams. These devious tactics have ensnared innocent individuals, further emphasising the urgency of robust cybersecurity measures.

In the realm of online romance, women often find themselves targeted by deceptive individuals who exploit their trust and longing for connection. Crafty scammers employ charming profiles and persuasive messages to manipulate emotions and orchestrate financial schemes, leaving unsuspecting women vulnerable to exploitation. As women navigate the digital landscape of dating platforms and social media, vigilance is crucial to thwarting the pervasive threat of romance scams and safeguarding against emotional and financial harm.

In a recent case that highlights the real-world impact of cyber fraud, a 49-year-old woman from Mahim fell victim to a social media likes fraud, losing INR9.38 lakh to cybercriminals. This incident underscores the need for continuous efforts in investigating and combating cybercrimes to ensure the safety and security of citizens in the digital age.[5]

In the intricate realm of cyberspace, only a handful of incidents manage to surface in the domain of the Cyber Cell, and an

Figure 11: Online scams in India



even more modest fraction finds its way into the public headlines. Yet, beneath this seemingly placid surface, there lies a pervasive and deeply rooted concern—the delicate interplay between awareness and the misuse of technology.

Misinformation: the fractured truth

In the coming two years, nearly 3 billion people are expected to participate in elections across multiple countries, including Bangladesh, India, Indonesia, Mexico, Pakistan, the UK, and the US. However, the escalating use of misinformation and disinformation, along with sophisticated dissemination tools, poses a substantial threat to the legitimacy of newly elected governments. The potential fallout from this deceptive information ranges from inciting violent protests and fostering hate crimes to potential civil confrontation and even terrorism.

A concerning aspect in India is the rising prevalence of AI voice scams, leading to financial losses for ~83 percent of the population. According to a report, 69 percent of Indians struggle to distinguish between an AI voice and a real one.[7] Approximately 47 percent of Indian adults have encountered or know someone affected by AI voice scams; a figure nearly

[4] https://www.business-standard.com/india-news/over-rs-10-300-cr-siphoned-off-by-cybercriminals-since-2021-says-i4c-124010300972_1.html
[5] https://i4c.mha.gov.in/cyber_digest/feb_2024/I4C%20Daily%20Digest-%2007.02.2024%20.pdf
[6] https://www.thehindu.com/news/national/aadhaar-enabled-payment-comprised-11-of-financial-frauds-i4c-analysis/article67706780.ece
[7] https://timesofindia.indiatimes.com/gadgets-news/new-ai-scam-is-targeting-indians-all-the-details/articleshow/99914367.cms

double the global average of 25 percent. Victims report significant financial losses, with 48 percent losing over INR50,000.

With 86 percent of Indian adults regularly sharing their voice data online, often through social media or voice notes, voice cloning has emerged as a potent tool for cybercriminals. This growing trend has eroded trust in social media, with 27 percent of Indian adults expressing reduced trust and 43 percent deeply concerned about the surge in misinformation and disinformation.[8]

Another noteworthy fraud is the customs fraud, recently highlighted by the government's fact-checking department, 'PIB Fact Check.' This initiative warned users about scams involving customs fraud through a post on social media. The post included a video demonstrating how scammers deceive individuals, disseminating misinformation while posing as customs officials.[9]

In a world increasingly dominated by technological advancements, the concept of truth has become a powerful yet fragile commodity. Today, technologies such as AI are being exploited to manipulate and distort truth, leading to the proliferation of misinformation. This misuse of technology has significant consequences, benefiting a select few while causing losses for the majority. As AI and similar technologies continue to evolve, it is crucial to address the misuse and safeguard the sanctity of information dissemination for the collective well-being of society.

Figure 12: AI voice scams in India

Number of people affected by AI voice scams

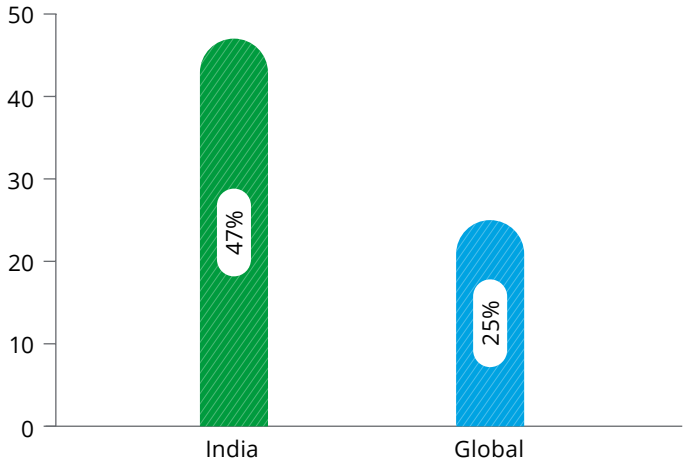


Figure 13: World Economic Forum risk ranking[1]

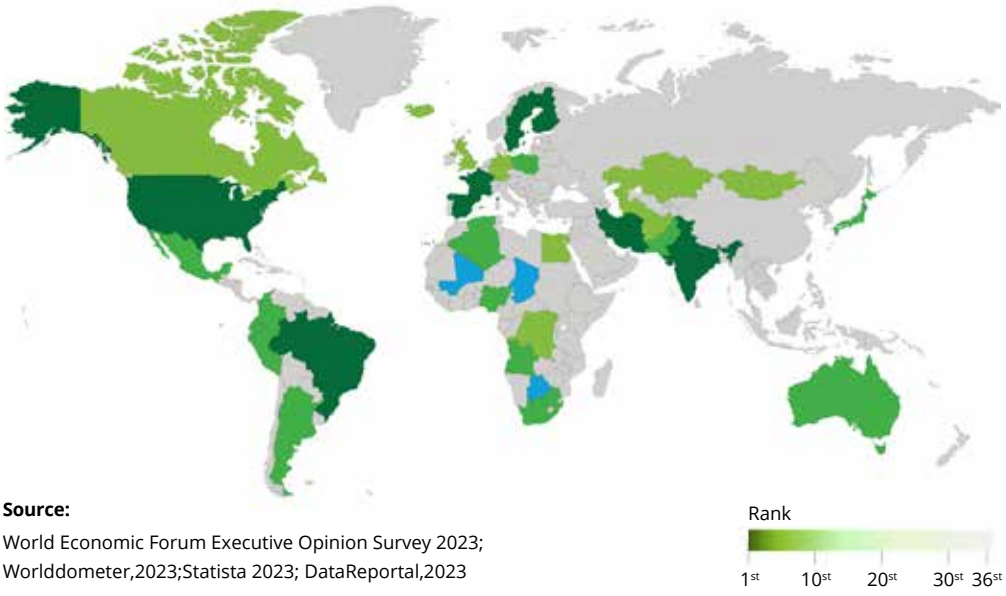
1st Risk in India
Over 1.4 billion head for a general election in April-May 2024

6th Risk in the US
Nearly 340 million head for a presidential election in November 2024

8th Risk in the EU
Nearly 450 million elect the EU parliament in June 2024

11th Risk in United Kingdom
Nearly 68 million head for a general election by January 2023

11th Risk in Mexico
About 128 millionhead for a general election in June 2024



Source:
World Economic Forum Executive Opinion Survey 2023; Worlddometer,2023;Statista 2023; DataReportal,2023

18th Risk in Indonesia
Nearly 278 million head for a presidential election in March 2024

22nd Risk in South Africa
Over 60 million head for a general election in March 2004

Russia
Around 145 million head for a presidential election in March 2024

[8] https://www.thehindubusinessline.com/info-tech/47-of-indians-have-experienced-ai-voice-scams-mcafee-survey/article66803142.ece
[9] https://pib.gov.in/factcheck.aspx

Deepfake misinformation: A growing concern

In the ever-evolving landscape of technology, the proliferation of deepfakes has emerged as a formidable threat to the digital integrity of nations, particularly in the context of impending elections. To address this pressing issue, Union Minister of State for Skill Development & Entrepreneurship, Electronics & IT, and Jal Shakti, Shri Rajeev Chandrashekhar, undertook a month-long initiative, convening pivotal stakeholder meetings with industry leaders. During these sessions, he underscored the urgent need for all platforms and intermediaries to strictly adhere to existing laws and regulations, emphasising the comprehensive nature of IT rules in tackling the deepfake menace.[10]

Deepfake technology has become a favoured tool for fraudsters seeking to exploit vulnerabilities in the digital realm. This advanced technology allows perpetrators to circumvent biometric authentication, employ sophisticated social engineering tactics, and manipulate AI algorithms. Their deceptive methods include the creation of synthetic biometric data, the use of realistic chatbots, and the production of deepfake videos for impersonation, as well as the fabrication of counterfeit documents. A recent survey highlights that over 90 percent of Indian companies are apprehensive about the security risks associated with Generative Artificial Intelligence (GenAI) tools. This underscores the dynamic nature of GenAI adoption, emphasising the critical importance of skill development and adherence to Zero Trust principles to unlock the full potential of this transformative technology.[11]

In response to the growing threat landscape, the government has taken proactive measures. Police chiefs across states and Union Territories were instructed to monitor suspicious activities that could disturb communal harmony and law and order. Additionally, a police think tank under the Union Home Ministry has issued advisories and alerts against various scams proliferating on social media platforms. The Bureau of Police Research and Development (BPRD) has identified seven types of fraud, ranging from trickery through missed calls to job offer and investment scams, emphasising the need for public vigilance.

Deepfake, fueled by AI, amplifies the threat to the safety and trust of our digital citizens. Indian PM Narendra Modi, recognising the gravity of the situation, issued a warning on 17 November 2023, drawing attention to the danger posed by deepfakes. In response, the MeitY conducted two Digital India Dialogues, engaging stakeholders from the Indian internet domain. These dialogues aimed to alert participants about the provisions outlined in the amended IT Rules of April 2023, specifically addressing 11 prohibited types of content on all social media intermediaries and platforms.[12]

While governmental organisations and media outlets have their limitations in addressing the challenges posed by synthetic media, individuals and organisations can play a pivotal role in overcoming these obstacles. At both the individual and organisational levels, proactive measures can be implemented to navigate through the media with a focus on safety and trust.

[10] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1990542

[11] https://www.zscaler.com/press/organisations-rush-use-generative-ai-tools-despite-significant-security-concerns

[12] https://pib.gov.in/PressReleseDetail.aspx?PRID=1990542

Strategic approaches for preparedness

To pave the way forward in preparedness, it is imperative to construct a robust cyber ecosystem—a sanctuary that embodies trustworthiness, security, resilience, and safety within India's digital terrain. Such an ecosystem stands as the cornerstone of our collective defence against emerging cyber threats and challenges. By fortifying our cyber infrastructure with these vital attributes, we not only safeguard our digital assets but also bolster the foundation upon which our technological advancements thrive.

Promoting collaboration among consumers, technology experts, law enforcement, and policymakers is essential for crafting thorough legal frameworks and regulations to tackle the swiftly evolving landscape of deepfake threats. This multifaceted strategy, incorporating technological advancements, vigilant surveillance, and collective endeavours, serves as a sturdy defence against the escalating risks associated with deepfake technology.

- **Zero trust solutions:** Business leaders are urged to adopt a holistic zero-trust architecture, encompassing comprehensive risk assessments, robust logging systems, and zero-trust-powered Data Loss Prevention (DLP) measures for all AI activities.
- **Regulatory policy measures:** The collaboration between the Indian government and private companies is crucial in mitigating the deepfake threat. MEITY has issued strict guidelines, holding social media companies accountable for AI-generated deepfakes on their platforms. Rule 3(1)(b)(v) specifically prohibits misinformation and patently false information, with MEITY closely monitoring compliance and proposing further amendments when necessary. The upcoming DPDP Act aims to regulate data collection and usage, potentially curbing malicious AI manipulation.
- **Cyber security measures:** Continuous investment in advanced security measures, responsible AI development, and robust data protection frameworks are imperative. Strengthening detection capabilities, forensic algorithms, audit processes, and cultivating the necessary talent are essential components in mitigating the risks associated with emerging technologies.
- **AI tools and technologies:** Investment in AI reinforcement tools to verify content authenticity and track the spread of misinformation is crucial. Skill training, awareness campaigns, collaborative efforts, and the responsible use of technology are pivotal in identifying and countering harmful content.
- **Partnership with tech giants:**
  - In anticipation of the Indian general elections in April–May 2024, a large cloud service provider has collaborated with news publishers and fact-checkers under the banner of SHAKTI - India Election Fact-Checking Collective. This strategic collaboration aims to create a common repository, equipping news publishers to effectively tackle the challenges posed by misinformation at scale.
  - **DigiKavach:** DigiKavach is an online fraud identification programme designed to prevent online financial fraud in India.
- **Global accords:** Acknowledging the global nature of the deepfake threat, technology companies are planning a new industry accord to combat deceptive AI election content. This initiative, set to be discussed at the Munich Security Conference, underscores the collaborative effort required to safeguard the integrity of major democratic elections worldwide.

Indeed, while solutions for organisations are relatively straightforward, ensuring security for end-users can be a nuanced and subjective endeavour. Nevertheless, there are several measures that individuals can take to bolster their own security in the digital realm. These include:

- Exercising caution when sharing personal information online and enabling security settings on social media platforms.
- Cross-checking information with reliable sources and scrutinising for signs of manipulated audio or video before sharing.
- Avoiding content from non-reputable sources and enabling two-factor authentication for added security.
- Regularly updating antivirus software and operating systems to protect against security vulnerabilities.
- Using strong and unique passwords for accounts to minimise the risk of unauthorised access.
- Verifying the identity of individuals requesting sensitive information through digital media channels.

The cybersecurity challenges and opportunities of the next decade will be proportionate to the pace and scale at which countries digitalise. As participants in India pointed out, larger populations correspond to a larger target for attacks, ranging from disinformation campaigns to fraud and extortion – familiar attacks that will only become more complex as criminals gain easier and cheaper access to more sophisticated technologies. The upside is that there is a window of opportunity for emerging and developing countries to implement “secure by design” principles that the first waves of digitalisation in more developed countries have largely failed to embed. To anticipate and address the cybersecurity challenges of the next decade, decision-makers should monitor the pace of digitalisation – and the ability of populations to integrate new technologies safely and securely – as closely as they do the security specifications of the technology itself.

Trend 6: Core workout: From technical debt to technical wellness

Indian businesses must shed the burden of legacy and outdated systems to advance in their quest for digital transformation. Modernising systems and IT is crucial for technical wellness.

In the dynamic realm of digital transformation, Indian enterprises are navigating the hurdles posed by legacy systems by embracing IT modernisation and ERP upgrades, setting the stage for innovation and growth. A significant 70 percent of these enterprises grapple with legacy IT systems, impeding their digital evolution. Today, digital transformation is not just a necessity but demands fresh perspectives on technical debt, human experience, and more to fully harness the benefits of a built-to-evolve organisation.

The impact of IT modernisation is far-reaching, encompassing increased sales, cost savings, heightened customer satisfaction, improved employee productivity, and enhanced security measures. As digitisation becomes seamlessly integrated into our daily lives, the pervasive use of software, both active and legacy, necessitates careful management to avoid an overwhelming technical debt. Notably, modernisation takes centre stage for most enterprises, with a staggering 88 percent allocating up to 60 percent of their tech budget to IT modernisation.[1] The top four key benefits encompass a productivity boost, diminished operational costs and tech debt, improved business agility, and enhanced scalability.

Delving into the technological forefront, cloud, DevOps, data analytics, AI, IoT, and security emerge as focal points of investment in IT modernisation. A notable 61 percent of enterprises express their intent to re-architect or rebuild legacy applications, signalling a proactive approach to technological evolution. Larger organisations, boasting revenues exceeding US$100 million, adopt a meticulously planned journey of modernisation, underpinned by a long-term vision. The transformative landscape is further fueled by the emergence of GenAI, 5G/6G, Web 3, and blockchain, technologies that are fundamentally reshaping the trajectories of IT modernisation journeys for enterprises on a global scale.

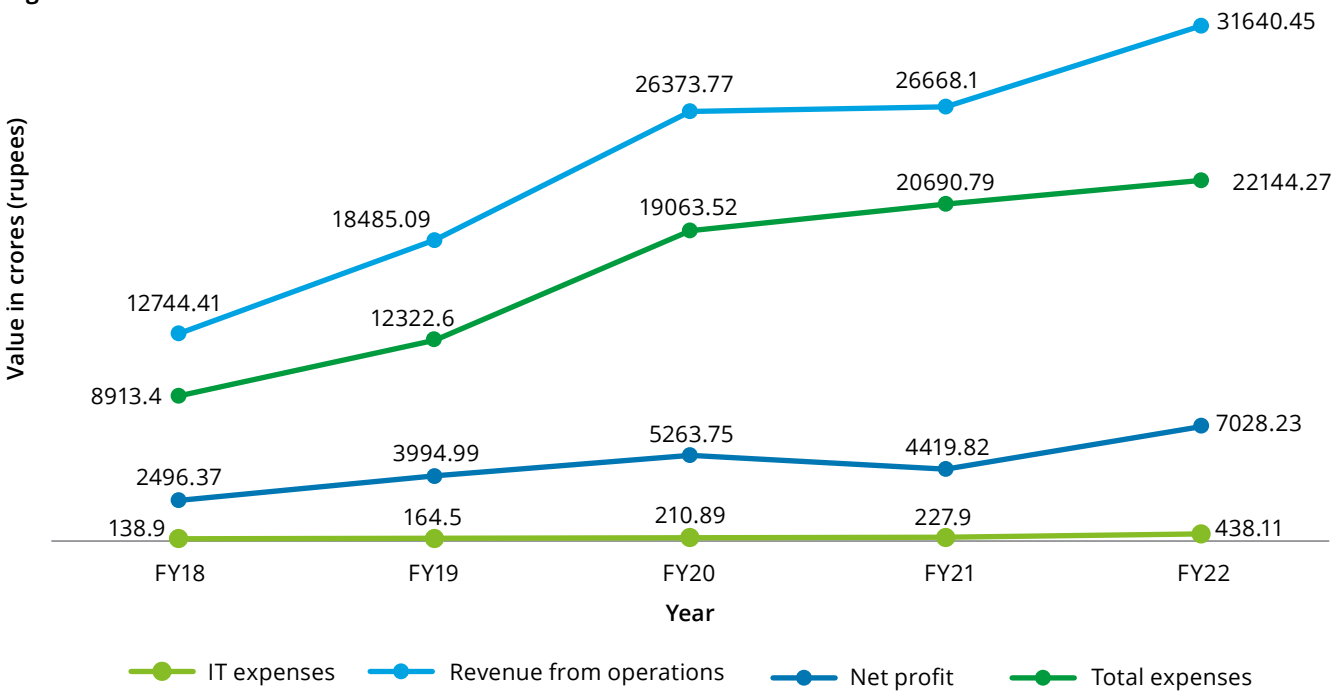
Examples of digital transformations success stories:

- In August 2023, the Indian government implemented the Digital Personal Data Protection Act, 2023 (DPDPA 2023) to regulate data protection within the country.[2] In the swiftly advancing digital age, robust legislation is imperative to ensure the protection of individuals' data. Amidst the vast exchange of information online, such legislation serves to shield our data from misuse and unauthorised access. Establishing digital trust is pivotal for expediting digital transformation and fostering substantial growth in the digital economy. Familiarity with regulations such as GDPR and similar laws in various nations underscores the significance of data protection.
- One of India's largest NBFCs has witnessed a remarkable surge in its tech spending surpass INR500 crore in FY23, exceeding the overall expense bill. The company’s strategic focus on digital transformation, initiated in FY22, encompasses a comprehensive omni-channel framework, big data integration, and cloud migration. Despite a slowdown in the global BFSI industry, its tech budget grew by nearly a third in FY23.

Over the last five years, tech spending has outpaced overall expenses, witnessing a fourfold increase, while profits have more than quadrupled during the period.Emphasising the pivotal role of technology in its business transformation, the company has transferred its entire data ecosystem and analytics workloads to public cloud, exploring cutting-edge tools such as knowledge graphs. The company sees technology as a key driver for product launches, customer acquisition, and elevating the overall customer experience. Gartner’s June 2023 report underscores the momentum in Indian banking and investing services' IT spending, which is projected to reach

[1] https://nasscom.in/knowledge-center/publications/2023-state-it-modernisation-securing-enterprise-competitiveness
[2] https://www.meity.gov.in/writereaddata/files/Digital%20Personal%20Data%20Protection%20Act%202023.pdf

Figure 14: IT revenue trends in India



US$11.28 billion in 2023, emphasising the growing investment in technologies for increased business outcomes.

- In 2021, an Indian automaker tackled a fragmented IT landscape with siloed data across business units. It executed a large ERP migration in the Asia Pacific Japan region, transitioning from on-premises to a managed cloud solution. This move aimed to address emerging trends such as digitalisation, smart manufacturing, and the integration of AI and machine learning. By implementing ERP Cloud, the company streamlined transactions, automated processes, and significantly increased employee productivity, empowering business users to self-serve automation needs. The migration, involving over 28,000 users and 309 interfaces, highlighted the company's commitment to sustainability by releasing 194 servers and reducing carbon emissions equivalent to planting 20,000 trees. With enhanced agility and future-readiness, the company can scale automatically, ensuring high availability with ERP Cloud. The flexible tools of the ERP Platform enable quick integration of new solutions, supporting adaptability to changing markets. As the company expands its ERP software footprint, it stands as a model enterprise, embodying the successful utilisation of ERP solutions to create an agile, efficient, and sustainable business ready to meet evolving demands.
- According to an RBI report, the Indian financial sector faced more than 13 lakh cyberattacks between January and October 2023. This means that banks and non-banking financial institutions faced ~4,400 cyberattacks every day.[3]

  The RBI has defined Regulated Entities (REs) as scheduled commercial banks (excluding regional rural banks); small finance banks; payments banks; and credit card issuing NBFCs.

  Per the RBI (Digital Payment Security Controls) directions, 2021, REs must adopt a "secure by design" methodology when developing digital payment products and services. They should guarantee that digital payment applications are inherently secure by integrating security measures throughout their development lifecycle.[4]

  The security of customers is a core business requirement, not just a technical feature. There is an increased focus on both security by design and privacy by design across digital transformation efforts, with many organisations prioritising security and privacy abuse cases right at the onset of an initiative.
- In a remarkable feat, an Indian financial services company has emerged as a trailblazer in the financial services sector by seamlessly embracing digital transformation and positioning itself as a leader. Spearheading its journey before the onset of the COVID-19 pandemic, the company's proactive adoption of technology has ushered in a new era

[3] https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=1253

[4] https://rbidocs.rbi.org.in/rdocs/notification/PDFs/MD7493544C24B5FC47D0AB12798C61CDB56F.PDF

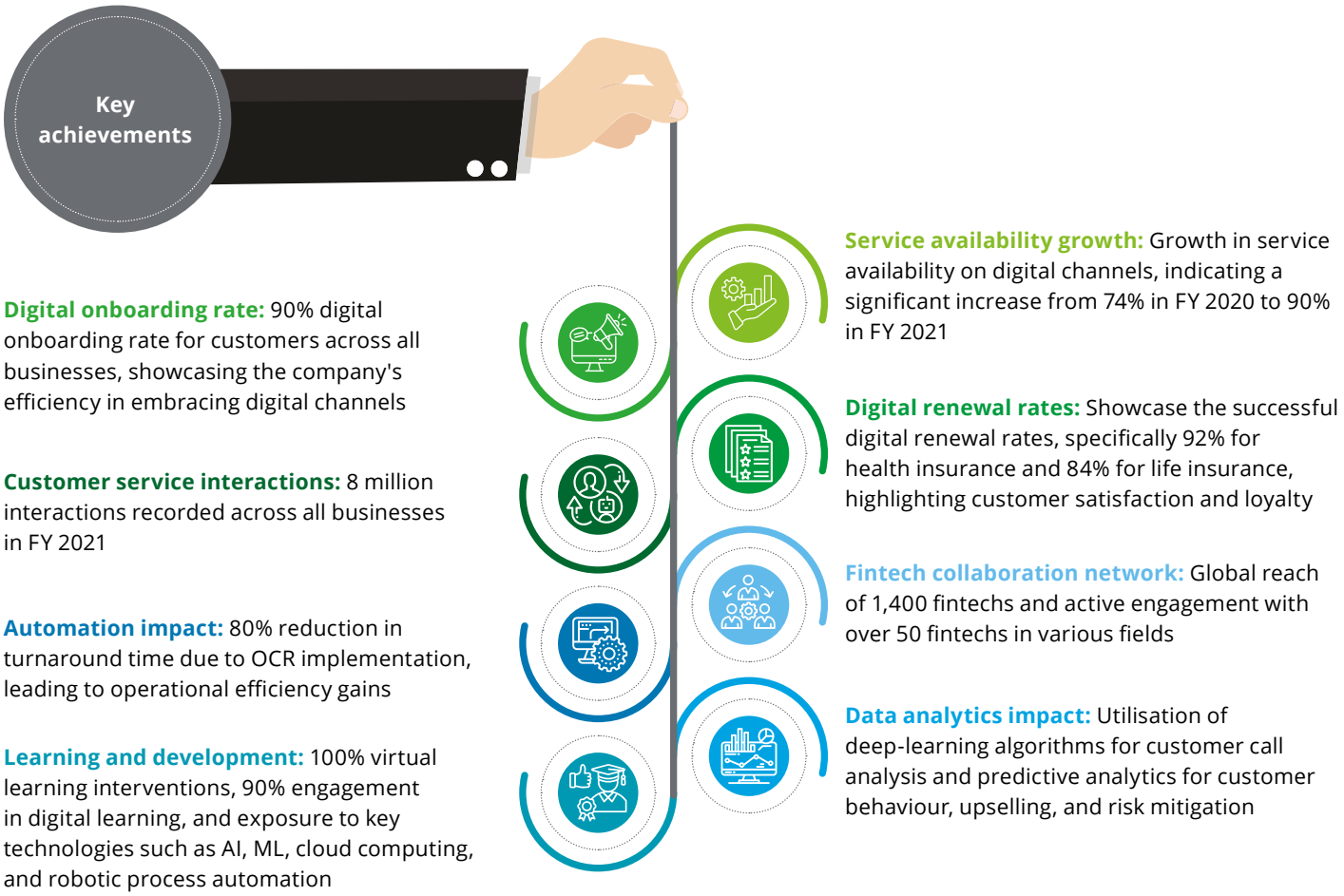
of improved customer satisfaction, heightened operational efficiency, and overall growth, setting an exemplary benchmark for the industry.[5]

Noteworthy highlights of the company's digital transformation trajectory include the re-engineering of over 100 customer and distributor journeys, achieving a 90 percent digital onboarding rate for customers across all businesses, and implementing digital service journeys on diverse platforms, from the web to chat providers and voice bots. The company's commitment to technological innovation is evident in the exponential increase in service availability on digital channels, reaching 90 percent in FY21, and recording a staggering 8 million customer service interactions across all sectors. Impressively, successful digital renewal rates of 92 percent for health insurance and 84 percent for life insurance underscore the efficacy of its digital initiatives.

The company's automation endeavours, featuring 350 robots performing live activities, email bots handling substantial volumes, and a remarkable 80 percent reduction in turnaround time due to Optical Character Recognition (OCR) implementation, underscore its commitment to operational excellence. Focused on fintech collaboration, the company boasts a global network of 1,400 FinTechs, actively collaborating in areas such as AI/ML, voice technologies, and digital KYC. Using data analytics, the company utilises deep-learning algorithms for customer call analysis, and predictive analytics for understanding customer behaviour, upselling, and risk mitigation, all contributing to an enhanced customer experience. A robust digital ecosystem spans protecting, investing, and financing businesses, underscoring the company's holistic approach to technological integration. The emphasis on people and culture is evident in its 100 percent virtual learning interventions, with over 90 percent of the workforce engaging in digital learning mediums, ensuring exposure to key technologies such as AI, ML, cloud computing, and robotic process automation.

The company's success during challenging times underscores the transformative power of digitisation, and it remains steadfast in its commitment to future-proof its strategy, aiming to endure as a preferred financial services provider through the continued harnessing of digital tools.

Figure 15: Key achievements through digital transformation for an Indian financial services company



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