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TATA CONSULTANCY SERVICES

Confederation of Indian Industry

Artificial Intelligence and Intellectual Property

Navigating opportunities and challenges in a transformative era

A comprehensive report on the evolution, opportunities, and challenges of Artificial Intelligence and Intellectual Property for the Indian industry

Content

Foreword

Mr. Chandrajit Banerjee
Director General – CII

The Report on 'Artificial Intelligence and Intellectual Property: Navigating opportunities and challenges in a transformative era', prepared in close association with Tata Consultancy Services, builds upon the earlier study and offers an updated perspective on a rapidly advancing domain. Over the last few years, Artificial Intelligence (AI) has moved from experimentation to large-scale integration across sectors, accelerating innovation cycles, and prompting important questions about ownership, valuation, and protection of intellectual assets. This publication provides a timely overview of global policy developments, emerging institutional approaches, evolving business models, and the shifting technology landscape that is shaping AI-driven Intellectual Property (IP) creation.

As India consolidates its position in the emerging digital economy of the world, Intellectual Property Rights (IPR) will play an increasingly important role in facilitating competitiveness, research-driven enterprise, and ensuring that innovation is aptly rewarded. The Report brings forth the imperative of alignment of IP regimes to altered realities-encouraging flexibility, forward-looking approaches that foster responsible technological advancement, clarity in rights apportionment, and collaboration with the safeguard of proprietary knowledge.

CII believes that these insights will be useful for Industry, policymakers, academia, and startups alike. We hope this report's analysis and recommendations will further encourage stakeholders to thoughtfully address the evolving IP ecosystem and proactively plan for the future of innovation during this AI-driven era.

Preface

Mr. Ashvini Saxena
Vice President and Head -
TCS Components Engineering Group
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The convergence of Artificial Intelligence (AI) and Intellectual Property (IP) represents one of the most profound shifts in the modern technological and legal landscape. Since 2019, AI has evolved from a niche research topic to a catalyst for transformation across industries, fundamentally altering how businesses innovate, compete, and protect their creations. This report, jointly prepared by Tata Consultancy Services (TCS) and the Confederation of Indian Industry (CII), seeks to illuminate the multifaceted relationship between AI and IP within the context of the Indian industry, with a particular focus on the rapidly expanding role of Micro, Small, and Medium Enterprises (MSMEs). This is an ongoing collaboration between TCS and CII to study the impact and development of AI and IP. The first report was jointly published in Dec 2019 titled “Understanding Dynamics of AI in IP”.

Our research undertakes a holistic examination of the evolution, adoption, and governance of AI technologies, tracing breakthroughs from deep learning and generative models to the emergence of agentic AI systems. We explore how these advancements have reshaped business environments, driving both opportunities and new vulnerabilities in IP management, legal frameworks, and operational strategies. Through comprehensive surveys, case studies, and patent analyses, the report documents the practical realities faced by Indian enterprises—highlighting both the promise and the challenges inherent in AI-driven innovation.

The study further investigates the shifting regulatory landscape in India and globally, dissecting legal precedents and compliance requirements that impact inventorship, ownership, copyright, and trademark protection in the AI era. Recognizing the unique hurdles encountered by MSMEs, we analyze barriers to technology adoption, skill gaps, and the ongoing need for accessible infrastructure and clear policy guidance.

In presenting actionable recommendations, this report emphasizes the necessity for robust IP strategies, responsible AI adoption, and collaborative policy interventions. Our goal is to enable stakeholders—industry leaders, policymakers, researchers, and entrepreneurs—to navigate the complexities of AI and IP, foster sustainable growth, and ensure equitable distribution of benefits. A balanced approach that integrates technological innovation with regulatory foresight, ethical standards, and continuous capacity building is the need of the hour.

As India stands on the threshold of an AI-powered future, this report aims to serve as a definitive resource for understanding the evolving intersection of AI and IP, informing strategic decisions and guiding the development of resilient, future-ready enterprises. We extend our gratitude to all contributors, survey participants, and industry experts whose insights have enriched this research, and we hope that the findings herein will inspire meaningful dialogue and decisive action in shaping the next decade of Indian innovation.

Acknowledgements

We extend our sincere appreciation to Tata Consultancy Services (TCS) and the Confederation of Indian Industry (CII) for conceptualizing and presenting the report titled 'Artificial Intelligence and Intellectual Property – Navigating opportunities and challenges in a transformative era' during the CII Global Summit on Technology, R&I and IP, 2025. This collaborative effort between TCS and CII reflects the shared commitment to fostering innovation, responsible AI adoption, and the evolution of IP frameworks in the digital age.

Our heartfelt gratitude goes to the TCS team—K Subodh Kumar, Dr. Sitarama Brahmam Gunturi, Vidya Vikas, and Dr. Anlin R—for their exceptional effort and expertise in authoring this report and delivering clarity and actionable insights for the AI and IP landscape. Special thanks to Himanshu Mehta and Sajitha K for their dedicated efforts as part of the editorial team, ensuring timely delivery and meticulous presentation. Our gratitude also extends to Ganesh Rajput for creating compelling visuals, Pinky Borah for her expert technical review that strengthened accuracy and readability, and Manjunatha M for conducting copyright checks to reinforce credibility and compliance.

We acknowledge R Saha and Rajarshi Bhowal from CII for their role in reviewing the report and for coordinating the survey—sharing forms, collecting responses, and providing insights that strengthened the report.

We appreciate Mr. Chandrajit Banerjee, for his insightful foreword that shaped the opening perspective of this report.

Mr. Ashvini Saxena
Vice President and Head -
TCS Components Engineering
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Solutions

Executive summary

Artificial Intelligence (AI) has rapidly evolved from a research-centric domain to a transformative, accessible technology impacting businesses of all sizes, especially India's Micro, Small, and Medium Enterprises (MSMEs). The proliferation of deep learning, generative AI (GenAI), and agentic systems—alongside advances in affordable cloud solutions—has accelerated AI's integration across healthcare, finance, manufacturing, and retail. Landmark innovations such as OpenAI's ChatGPT have revolutionized content creation, customer engagement, and operational efficiency. Government initiatives and public-private partnerships have further catalyzed AI literacy and adoption, although MSMEs continue to face barriers related to affordability, infrastructure, talent gaps, and complex regulatory requirements.

The AI patent landscape in India reflects this momentum, with filings surging—particularly in GenAI and agentic technologies. Nonetheless, only a fraction of applications have been granted, highlighting ongoing challenges in legal clarity and patent examination. Patent trends show a shift from foundational technologies to specialized applications in healthcare, education, and business intelligence, with GenAI models and Large Language Models (LLMs) driving a majority of patent activity. MSMEs, while benefitting from increased access to AI, struggle with IP protection due to technical complexity, ambiguous ownership, and evolving legislation.

The widespread adoption of AI has led to significant risks, notably in establishing its trustworthiness and in Intellectual Property (IP) management. Legal frameworks originally designed for human inventors are under strain amid questions over inventorship, ownership, eligibility, and infringement. Global legal precedents have clarified that only humans may be considered inventors, routine AI applications are not always patentable, and AI-generated content often lacks copyright protection. New forms of risks—lack of transparency, bias, misinformation, deepfakes, hallucinations while using LLMs, and trademark misuse—have prompted calls for stronger governance and ethical standards.

MSMEs face practical hurdles in mitigating these risks, often with limited expertise and resources. Integration of AI with fragmented digital infrastructures, data privacy concerns, regulatory ambiguity, and challenges in upskilling remain persistent. However, recent advances in plug-and-play AI solutions, low-code platforms, and targeted government support are lowering barriers to entry.

To address evolving risks, the report recommends robust IP strategies and responsible AI adoption. Organizations should:

- Document human contributions and strengthen patent specifications.
- Conduct due diligence on training data and leverage a mix of patents, trade secrets, and licensing agreements.
- Monitor AI outputs for copyright and trademark risks.
- Invest in workforce upskilling and interoperability across digital platforms.

Policy interventions are critical to harmonize global IP frameworks, introduce sui generis protections for AI-generated assets, and promote ethical, transparent AI use. MSMEs should focus on incremental digital transformation, accessible training, and building an ecosystem that supports inclusive, responsible AI adoption. Case studies highlight that operationalizing AI within core business workflows, prioritizing explainability, and balancing automation with human expertise are essential for sustained competitiveness.

Ultimately, the coming decade will determine whether AI serves as a catalyst for empowerment or exacerbates inequality among India's small businesses. A balanced, inclusive roadmap—combining technological innovation, regulatory foresight, and continuous capacity building—will be essential to ensure that the benefits of the AI revolution are widely shared, fostering resilient and future-ready enterprises.

Objectives and scope

The TCS-CII Report on Artificial Intelligence (AI) and Intellectual Property (IP) aims to provide a comprehensive analysis of the evolving landscape of AI and its intersection with IP, with a particular focus on developments since 2019. The objectives and scope of the research work are as follows.

Technological evolution of AI

- Deliver an updated overview of AI advancements, especially in GenAI models (such as GPT-4 and DALL·E), agentic AI systems, and novel neural network architectures.
- Examine shifts in application experiences, including conversational and assisted interfaces.
- Assess breakthroughs in compute optimization and AI infrastructure that support new capabilities.
- Discuss AI's expanding influence in accelerating research and development (R&D) and innovation cycles across various industries.

Business environment transformation

- Analyze sector-specific AI adoption and disruption within IT services, manufacturing, finance, healthcare, media, and particularly the Micro, Small, and Medium Enterprises (MSME) sector, highlighting unique challenges faced by MSMEs in adopting AI and Small Language Models (SLMs).
- Survey the transformation of IP management and business models through AI-enabled products and services.
- Address the evolution of AI from a tool to a creative and autonomous agent in innovation processes.
- Identify risk factors associated with AI (including LLMs and SLMs), such as bias, hallucinations, data privacy, and training on non-specific datasets.
- Integrate responsible AI principles—ethics, fairness, transparency, and privacy—into the analysis of the technology landscape.

AI patenting trend in India

- Present the current vitality of AI research, patent trends, and key milestones in achieving human-level performance.
- Examine evolving trends in IP creation, protection, and management in the era of GenAI.

Challenges in IP management and protection

- Address critical IP issues, including authorship and ownership of AI-generated works, use of copyrighted training data, copyright protection for AI outputs, deepfakes, personality rights, trade secret risks, and cross-border enforcement complexities.
- Provide sectoral insights and updates on case law, including landmark decisions on AI inventorship and copyright disputes.
- Review global AI regulations, governance models, and compliance requirements affecting IP and business operations.
- Discuss the impact of regulatory frameworks on strategic planning, risk management, and IP enforcement for AI-driven enterprises, and highlight governance mechanisms that balance innovation with ethical and legal obligations.

Enterprise-grade AI adoption and IP risk mitigation

- Address practical challenges in scaling GenAI and agentic AI within enterprises.
- Explore IP risk mitigation strategies, compliance frameworks, and governance best practices.
- Discuss the management of expectations and maturity challenges related to AI capabilities, acknowledging the current "hype" phase.
- Include survey insights on enterprise risk management and present Indian industry case studies illustrating these challenges.

IP strategy and policy recommendations (India specific)

- Propose actionable policy interventions to foster innovation, ensure ethical AI use, and strengthen IP protection in India.
- Address accountability and responsibility in multi-stakeholder collaborations among vendors, enterprises, and regulators.
- Articulate the importance of aligning IP management with responsible AI principles and emerging technology trends.
- Provide specific guidelines for AI implementation tailored to large enterprises and MSMEs.

Overall, the scope covers technological, business, legal, and regulatory dimensions of AI and IP, with sectoral and India-specific perspectives, aiming to inform policy, industry practices, and future research.

1

Landscape of developments in AI

Landscape of developments in AI

AI is revolutionizing enterprises—driving bold innovation, unleashing new competitive strengths, and redefining the future of business, while exposing critical risks that demand vigilant, responsible leadership.

1.1. Evolution of AI

Artificial Intelligence (AI) has shifted from a futuristic concept to an accessible, transformative technology shaping businesses of all sizes. Tools that once required specialized teams are now widely available through user-friendly interfaces and affordable subscriptions. In India, AI's evolution has played a key role in boosting the economy, promoting digital inclusion, and supporting Micro, Small, and Medium Enterprises (MSMEs) by automating processes, improving decision-making, and enhancing customer experiences. The rise of GenAI and autonomous agents—highlighted by OpenAI's ChatGPT in 2022—has driven innovation and efficiency across industries. However, challenges such as misinformation, deepfakes, copyright issues, and accountability concerns have emerged, especially for smaller enterprises. This study explores major AI breakthroughs since 2019 and their significant impact on the Indian industry, emphasizing the need for balanced, equitable implementation.

1.2. Key features of AI landscape

Table 1.1 presents the landscape of key AI developments across the globe with specific references to the Indian context.

Table 1.1: Key features of AI landscape

Year	Across the globe	India
2019	• **Deep learning supremacy:** Neural networks, especially convolutional networks, powered state-of-the-art results in computer vision and Natural Language Processing (NLP). • **Rise of transfer learning:** Pre-trained models like BERT (2019) started transforming NLP tasks, enabling enterprises to fine-tune models for their specific use cases. • **Cloud dependency:** Most AI adoption was tied to hyper scalers like AWS, Azure, and Google Cloud. MSMEs largely consumed AI via Application Programming Interface (APIs). • **Limited regulation:** While ethics was a popular topic, there were no binding regulations. The EU had issued its AI ethics guidelines, but enforceable law was years away.	• India was in its early AI adoption phase, with **NITI Aayog's AI strategy (2018)** serving as the foundation. MSMEs showed interest, but AI was mostly adopted by large IT service providers and startups.

Landscape of developments in AI

Year	Across the globe	India
2020	• **Accelerated AI adoption across industries:** AI technologies including NLP, Computer Vision (CV) saw widespread adoption across sectors such as healthcare, finance, retail, and manufacturing. • **Rise of GenAI:** GenAI systems capable of producing novel content such as text, images, and music gained prominence. • **Global AI Strategy Development:** Many countries started developing AI strategies including investments in AI Research, development of ethical guidelines, and initiatives to promote AI literacy. • **Ethical and regulatory considerations:** The rapid advancement of AI technologies raised concerns about ethics, data privacy, and potential for misuse.	• **Challenges in adoption:** Low adoption among Indian MSMEs due to key barriers including high cost of AI tools, infrastructure, limited awareness, and lack of skilled workers. • **Collaboration with private sector:** NITI Aayog partnered with companies such as Adobe, Microsoft (MS) to promote AI literacy and adoption among MSMEs. • **Focus on AI-ready workforce:** Programs such as FutureSkills PRIME, a joint initiative between MeitY and NASSCOM, aimed to upskill India's workforce in emerging technologies, including AI, to support MSMEs in their digital transformation journey.
2021	• **Dominance of Deep Learning:** Deep Learning continued to dominate fields such as CV, NLP, and Reinforcement Learning (RL). Advances in GPT-3, DALL·E revolutionized tasks such as translation, content generation, and conversational AI. • **AI in healthcare:** AI driven tools for diagnostics, predictive analytics, and drug discovery became more prominent. Models that could predict protein binding such as DeepMind's AlphaFold, received significant attention. • **AI in autonomous vehicles and robotics:** Significant improvements in self-driving car technology, especially from companies such as Tesla and Waymo. • **AI ethics:** The use of AI raised concerns over privacy, bias, transparency, and accountability. There was growing interest in ensuring AI models were fair and did not perpetuate systemic bias. The EU proposed the AI Act in April 2021, aimed at creating a legal framework for trustworthy AI. This legislation was poised to set global standards for AI safety and regulation. • **Venture capital investment:** AI startups continue to attract significant funding. Companies in industries such as healthcare, finance, logistics, and cybersecurity received a chunk of VC funding. • **AI as a Service (AIaaS):** Cloud platforms such as AWS, Google Cloud, and MS Azure made AI tools more accessible. AI as a Service allowed smaller companies and startups to leverage powerful AI models without heavy infrastructure investment.	• **Early adoption:** AI adoption in MSME sector was still in the early stages. While larger enterprises were leveraging AI for automation, the MSMEs were cautious and had limited resources. However, awareness around AI's potential to drive efficiency, automation, and growth started to increase. But there was a general skill gap in understanding nuances of AI. • **Challenges faced by MSME:** Limited access to AI infrastructure—the costs associated with AI infrastructure were a barrier for MSMEs. Cloud-based AI solutions were making AI more accessible at affordable costs. • **Data privacy concerns:** Given the relatively informal nature of many MSMEs in India, data privacy and security were a concern. Many smaller businesses lacked robust data security measures, which is critical when using AI tools. • **Government support for digitization:** The Indian government launched several initiatives such as "Atmanirbhar Bharat" to encourage digitalization and innovation, which included supporting MSMEs in adopting new technologies such as AI.

Landscape of developments in AI

Year	Across the globe	India
2022	• **Widespread AI integration:** AI continued its integration across industries, especially in healthcare, retail, finance, automative, and manufacturing. AI-powered solutions became increasingly critical, especially as businesses adapted to post-pandemic economic realities and labor shortages. • **Ethical AI and governance:** The EU moved closer to finalizing its AI Act, which is aimed at creating a regulatory framework for high-risk AI systems to ensure safety, privacy, and fairness. • **AI in the Metaverse and Web 3.0:** Metaverse technologies began integrating AI to enhance user experiences such as creating AI-driven and dynamic virtual worlds.	• **Growing interest in AI among Indian MSMEs:** According to surveys, over 20% of MSMEs had started integrating AI and cloud-based solutions into their operations, mostly for supply chain optimization, predictive analytics, and CRM. • **Government support for AI in MSME:** Programs such as "AI4All" from Niti Aayog focused on upskilling small business owners and employees in AI-related fields. • **AI-powered innovation in Indian MSME:** Companies such as Zest AI and Flutura were helping Indian MSME leverage AI for predictive maintenance, supply chain optimization, and sales forecasting.
2023	• **AI regulation and ethical standards emerge:** The EU AI Act was officially passed with a focus on high-risk AI systems, emphasizing transparency, accountability, and ensuring AI safety for citizens. • **Focus on responsible AI:** Concerns around bias, privacy, and future of work were increasingly addressed, with many countries focusing on AI ethics and creating responsible AI practices. • **AI in automation and workforce:** Workforce was significantly impacted as AI adoption led to the replacement of repetitive jobs. • **AI for sustainability and climate change:** Notable increase in AI-driven solutions targeting climate change and environmental sustainability.	• **Government programs:** PM Gati Shakti was a key program to support MSMEs in logistics and supply chain management, integrating AI and data analytics to optimize operations. • **AI in Indian MSME operations:** MSMEs began using AI-powered tools for demand forecasting, price optimization, and predictive analytics to remain competitive in rapidly changing markets. • **AI as a Service and MSMEs:** Companies such as Wipro Ltd, TCS Ltd, and Zoho provided AI-powered solutions tailored for Indian MSMEs, offering tools for automation, data analytics, and predictive modeling. Startups specializing in AI solutions for agriculture (AgriTech platforms) and e-commerce platforms provided affordable tools that MSMEs could integrate into their operations.

Landscape of developments in AI

Year	Across the globe	India
2024	• **Increased adoption of GenAI in industry:** 2024 has seen GenAI expand beyond creative fields for content creation to industries such as healthcare, finance, law, and education. Multimodal AI models have gained significant traction. Use of SLMs also witnessed increasing adoption. • **AI agents and autonomous systems:** There has been a shift from GenAI to development of more autonomous, goal-driven AI systems. These systems are now capable of running complex simulations for scientific research, decision making in healthcare, or act as personal assistants that adapt to user preferences. • **Regulations and governance:** EU is moving closer to implementing its AI Act, setting a global benchmark for AI regulations. Several other countries are also drafting or enhancing their own AI regulation frameworks. • **AI in sustainability:** 2024 witnessed a surge in "Green AI" efforts to reduce environmental impact of AI development. Companies are investing in energy-efficient algorithms, and governments are mandating sustainable AI practices. • **Quantum computing and AI:** Quantum computing is slowly becoming more integrated with AI research; several companies have made breakthroughs in using quantum algorithms to optimize ML models and AI systems.	• **India AI Mission:** Aims to foster a robust AI ecosystem by: ○ focusing on compute infrastructure, creating platforms to host datasets, models. ○ promoting research, innovation, and skill development in AI. Achieved milestones such as establishing AI CoEs and launching programs to support startups and AI talent across the country. • **Increased digital transformation in MSMEs:** Indian MSMEs embraced AI and ML at an accelerated pace in 2024. With government push for a digital India, MSMEs that hesitated to adopt AI were now motivated to do so due to lower energy costs and increasing cloud computing options. • **AI for manufacturing MSME:** AI and ML tools continued to help manufacturing MSMEs with predictive maintenance, quality control, and automation of product lines. • **AI-driven financial inclusion:** In 2024, AI-powered FinTech solutions became crucial for financial inclusion, particularly for Indian MSMEs that struggled to access credit and loans from traditional banks. • **AI challenges for Indian MSMEs:** Affordability remained a challenge with many small businesses still struggling to access affordable AI tools and cloud computing solutions. Talent gap persisted; despite rising talent, there was still a shortage of AI professionals.

Landscape of developments in AI

1.3. The breakthrough of generative AI

A significant turning point occurred in 2022 with the introduction of OpenAI's ChatGPT, marking a new era wherein AI systems demonstrated the capacity to generate coherent, creative, and contextually sophisticated content. Unlike previous chatbots, GenAI could produce essays, marketing materials, software code, and even poetry. By 2023, GenAI became an integral component of daily operations for global corporations and MSMEs across India. Indian startups rapidly integrated these models to optimize content creation processes, automate customer service, and expedite software development. Nevertheless, this rapid adoption was accompanied by emerging concerns regarding misinformation, bias, and hallucinations—risks that had not been fully anticipated in 2019.

1.3.1. Emergence of agentic AI and AI agents

By 2024, the landscape evolved further with the advent of agentic AI—systems capable of autonomously planning, executing, and refining tasks with minimal human intervention. Contrasting passive chatbots, AI agents were able to orchestrate workflows, integrate with APIs, and function with a degree of independence akin to digital employees. Innovations such as Auto-GPT and LangChain-enabled frameworks exemplified the expanded capabilities of AI in complex operational roles. This progression presented valuable opportunities to MSMEs, including AI-driven procurement and autonomous financial advisory services, but simultaneously elevated concerns regarding accountability, safety, and unpredictability in decision-making.

Although large enterprises frequently garnered attention during this period, MSMEs also realized substantial advantages from AI implementation. The technology is no longer exclusive to major tech companies; it has become more accessible, affordable, and impactful than ever before. From streamlining operations to enhancing customer engagement, AI emerged as a strategic catalyst for MSMEs striving to sustain competitiveness in a rapidly evolving market environment.

1.3.2. Risks realized in retrospect

Many risks associated with AI only became apparent post-adoption. Initially perceived primarily as a technical tool with risks limited to data privacy and algorithmic bias, broader challenges surfaced between 2022 and 2023. This included incidents of AI hallucinations resulting in false yet confident outputs, the spread of deepfakes affecting electoral integrity, disputes over copyright concerning AI-generated art, and issues related to the opacity of Large Language Models (LLMs). These concerns, which were not fully addressed in early deliberations, gained prominence only after widespread utilization. MSMEs, often lacking sufficient resources, were particularly exposed to reputational, legal, and operational vulnerabilities arising from these developments.

- In conclusion, advancements in AI since 2019 represent both technological innovation and a pivotal societal shift. For Indian industry, AI offers the possibility to overcome longstanding obstacles and compete on a global scale. However, this progress is coupled with considerable challenges, including safeguarding data privacy, adhering to regulatory standards, mitigating digital inequality, and managing unforeseen risks. The next decade will be instrumental in determining whether AI serves as a vehicle for empowerment of millions of small businesses or inadvertently exacerbates existing disparities. A balanced approach, integrating innovation, regulation, and inclusivity, will be critical to ensuring that the benefits of the AI revolution are distributed equitably.

2

Business environment transformation

Business environment transformation

The rapid evolution of AI has significantly reshaped the landscape of IP management, business operations, and innovation strategies across industries. As Indian enterprises—both large corporations and MSMEs—embrace AI and, more recently, generative and agentic AI, they encounter new opportunities as well as profound challenges.

This section explores key insights derived from the TCS-CII Report on Artificial Intelligence (AI) and Intellectual Property (IP), which provides an in-depth survey of how organizations leverage AI-powered solutions for IP creation, protection, utilization, and commercialization. It also highlights the transformative impact of AI on business models, the diverse range of applications driving efficiency and growth, and the emerging risks and support needs that accompany this technological revolution. Drawing on detailed case studies and survey responses, the following analysis offers a comprehensive overview of AI adoption trends, challenges, and future directions among both large enterprises and Indian Micro, Small, and Medium Enterprises (MSMEs), setting the stage for strategic policy, capacity building, and responsible innovation in the era of AI-driven business transformation.

2.1. Key insights from large enterprises

The TCS-CII Report on AI and IP presents a comprehensive survey designed to assess the impact of AI, with a particular focus on GenAI, on the creation, protection, usage, and commercialization of IP.

Among large enterprises, sectors such as Information and Communication Technology (ICT), Life Sciences, Manufacturing, Automotive, Power, and Aviation were covered. MSMEs included participants from diverse fields such as Automotive, Banking and Financial Services Industry (BFSI), Information and Communication Technology, Life Sciences, Manufacturing, Retail, Hospitality, Education, Renewables, Logistics, Environmental Services, and Consulting. Responses were gathered from organizations of various sizes and industries.

Respondents spanned roles from leadership and management to technical, operational, and Human Resources (HR) staff, providing a comprehensive view of AI adoption across organizational functions.

- Industry feedback indicates that both generative AI and agentic AI are making significant advancements, positively influencing products and services available in the market. The adoption of these technologies for reinventing offerings continues to grow.

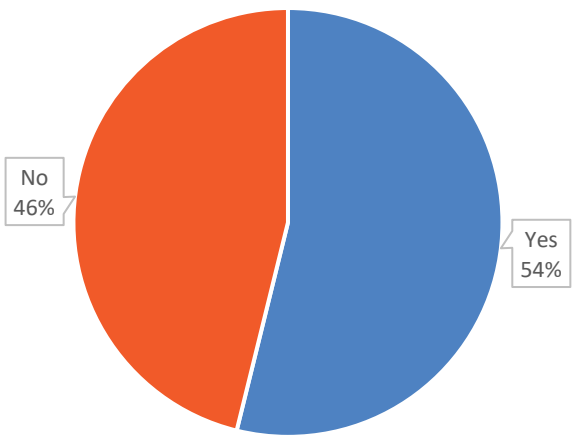


Fig 2.1: Chart representing use of GenAI in AI-enabled products and services

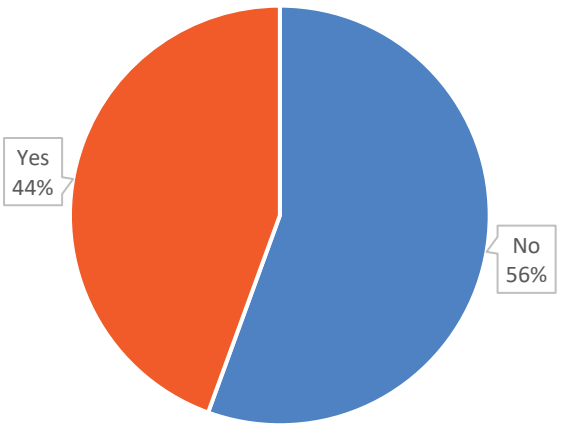


Fig 2.2: Chart representing use of GenAI + Agentic AI in AI-enabled products and services

Business environment transformation

- The questionnaire targets organizations across various industry sectors and sizes, exploring their adoption and experiences with AI-enabled products and services in IP management and broader business transformation. There is an increased trend to use AI enabled products and services for businesses. 69% of the respondents are using AI-assisted, AI-powered, AI-driven products and services for business. They encompass customer experience enhancement (such as chatbots, personalization), process automation and optimization, predictive analytics and decision support, new product/service development, supply chain and logistics management, and marketing and sales optimization.

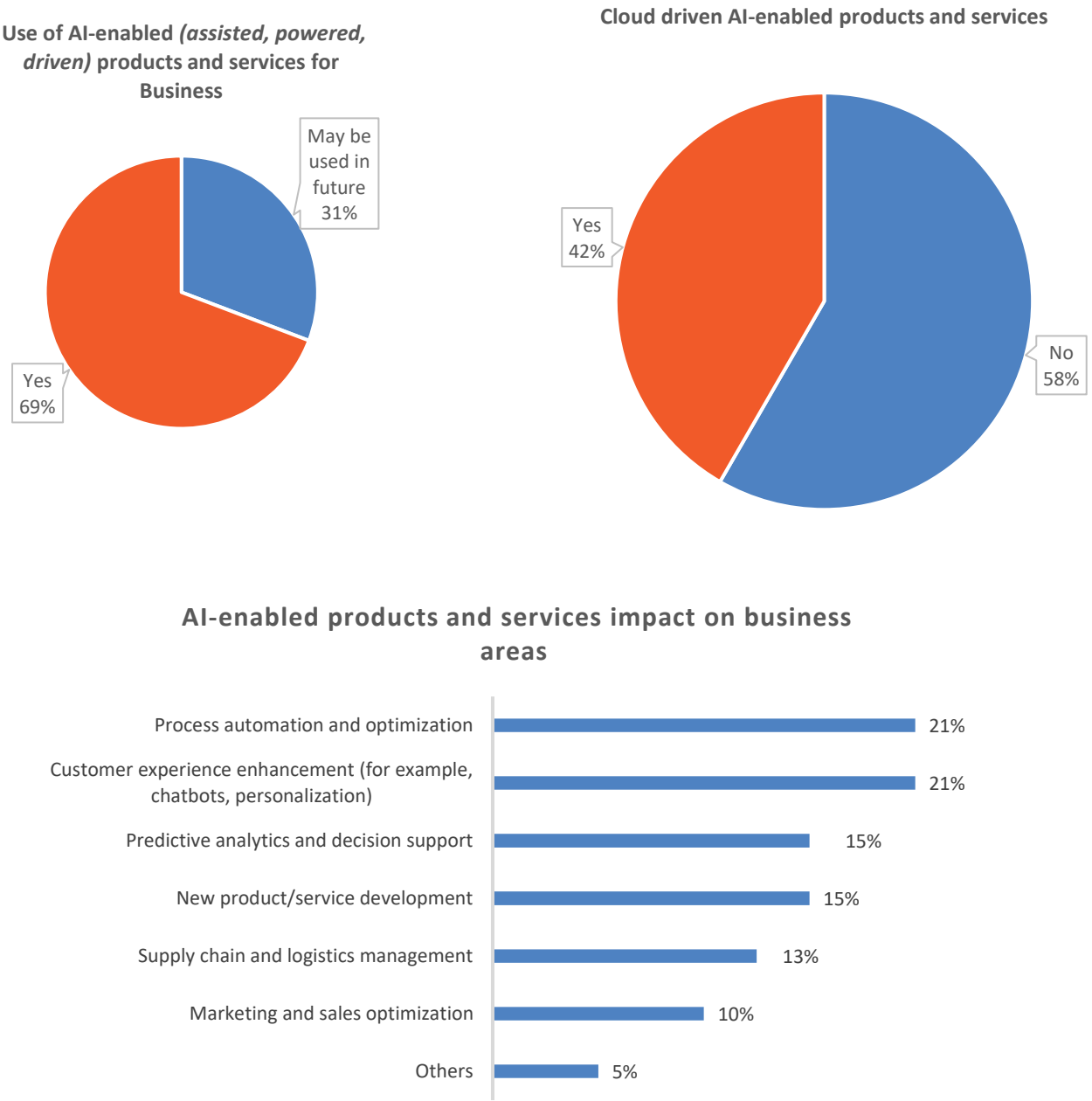


Fig 2.3: Charts representing use of AI-enabled and cloud driven AI-enabled products and services for business and its impact on business areas

- A key focus of the questionnaire is to evaluate the business outcomes organizations expect from AI adoption—such as improvements in time efficiency, manpower optimization, accuracy, decision-making, scalability, customer satisfaction, business opportunities, and competitor intelligence.

Business environment transformation

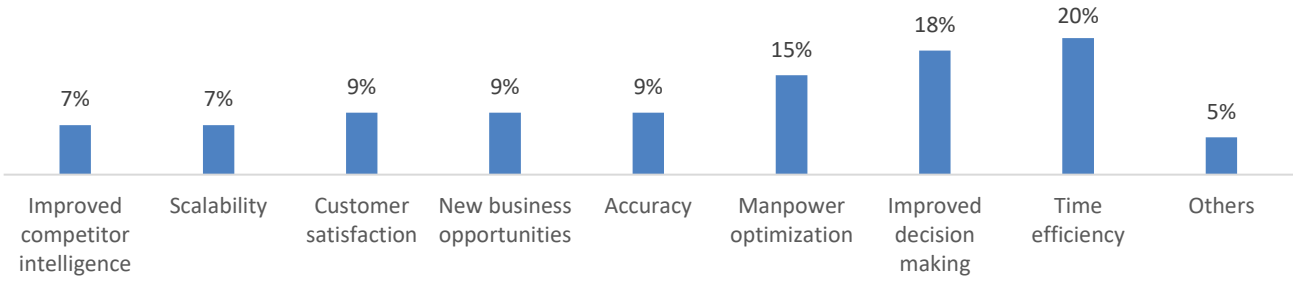


Fig 2.4: Chart representing business outcomes using AI-enabled products and services

- The survey also probes the challenges faced in creating and protecting IP in the AI and GenAI domains, including issues of authorship, ownership, copyright, regulatory clarity, cost, and cross-border enforcement.

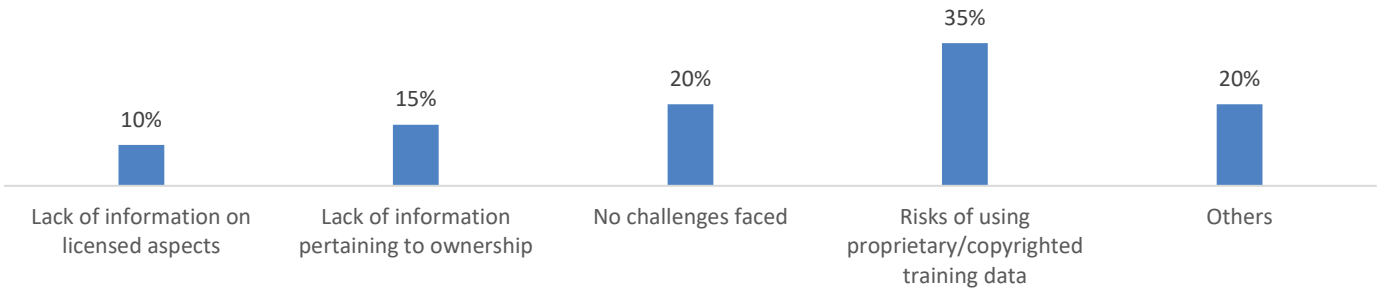


Fig 2.5: Chart representing challenges faced in creating AI-enabled products and services

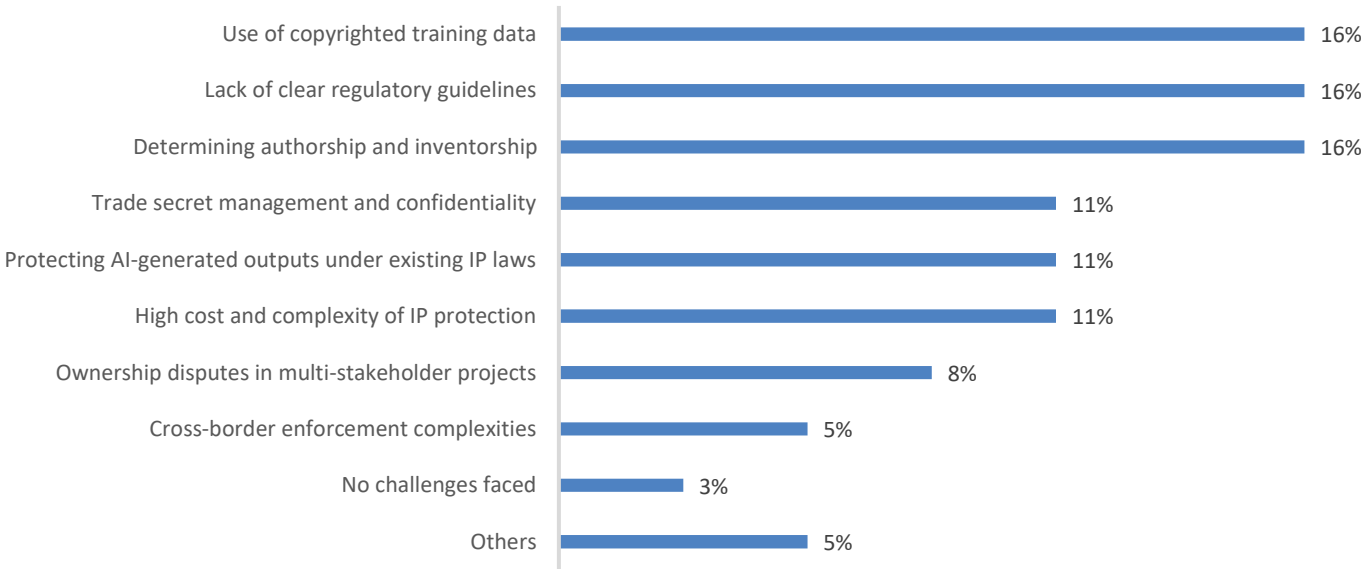


Fig 2.6: Chart representing challenges in creating and protecting IP in AI/GenAI domain

Other challenges Include:

- Risk of compromising valuable technical details which are confidential
- Confidentiality for defence products

- Respondents are asked to assess whether AI-enabled solutions have met their expectations, and to identify both opportunities and challenges posed in adopting emerging technologies such as AI, Quantum Computing, Cybersecurity, IoT, Blockchain, Cloud Computing, AR/VR, Digital Twins, and Clean Energy.

Business environment transformation

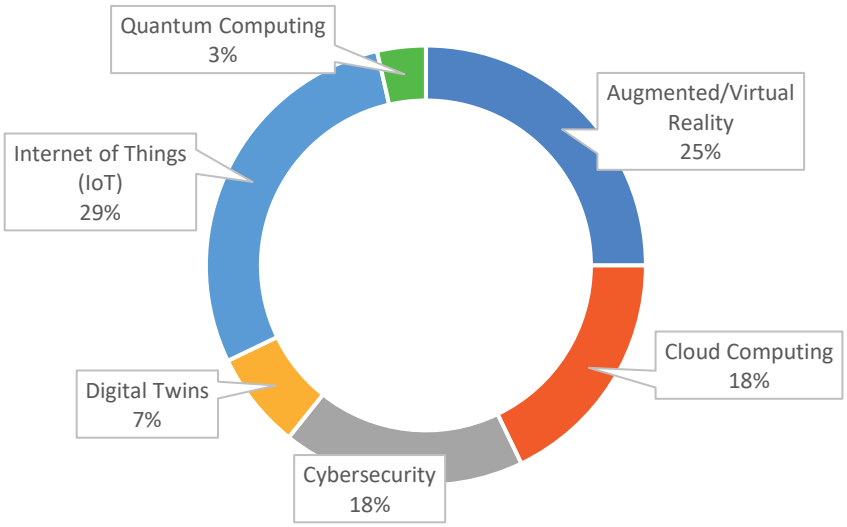


Fig 2.7: Chart representing emerging technologies for AI-enabled business environment

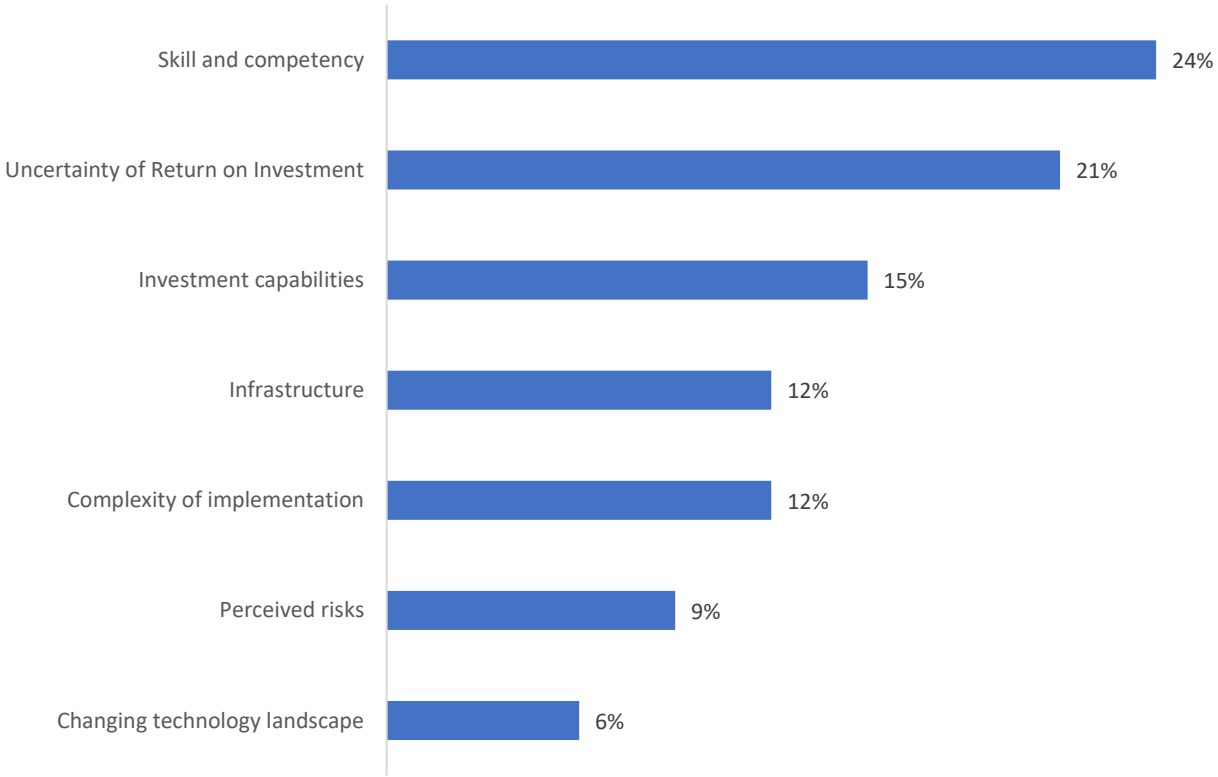


Fig 2.8: Chart representing challenges in adopting emerging technologies

- The questionnaire further investigates perceived risks in adopting AI/GenAI (such as data privacy, legal, ethical, reliability, and IP risks) and the effectiveness of various mitigation strategies, including leadership directives, training, technical controls, regulatory alignment, and workforce upskilling.

Business environment transformation

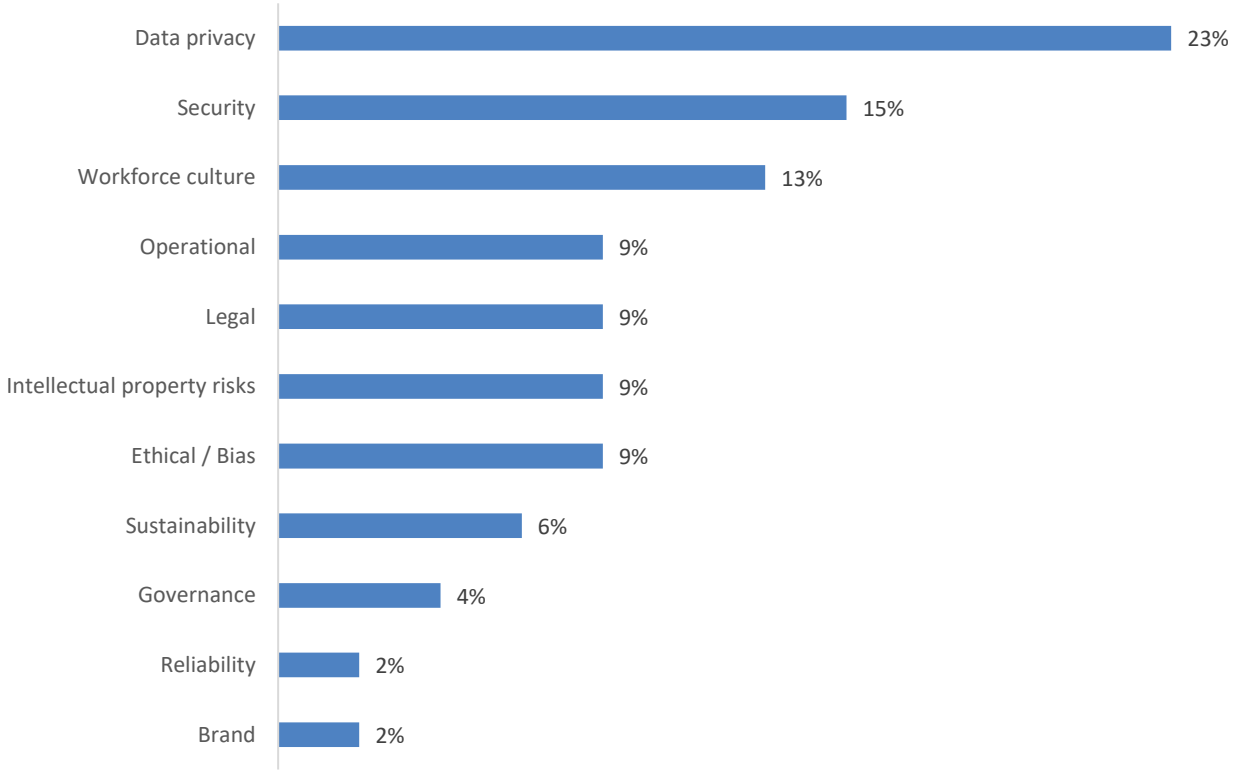


Fig 2.9: Chart representing risks in adopting AI/GenAI

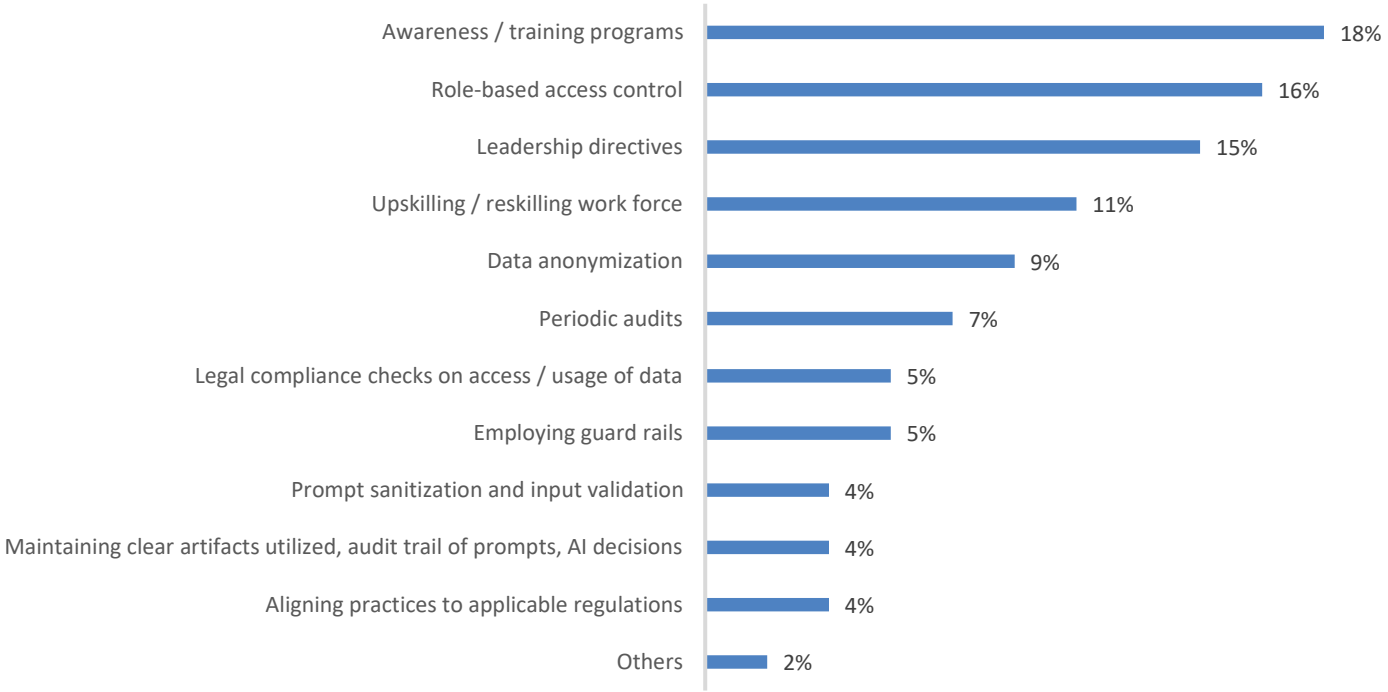


Fig 2.10: Chart representing means of addressing risks in adopting AI/GenAI

- The survey explores how organizations address skill gaps in AI adoption and seeks recommendations for policy interventions to enhance AI/GenAI uptake and drive business growth—such as increased access to datasets, cloud subsidies, regulatory guidelines, funding for pilots, and advisory tools. It also assesses approaches to collaboration and IP rights management in AI projects, governance and compliance frameworks**,** and the integration of responsible AI principles (fairness, transparency, privacy, accountability, inclusivity, and ethical monitoring).

Business environment transformation

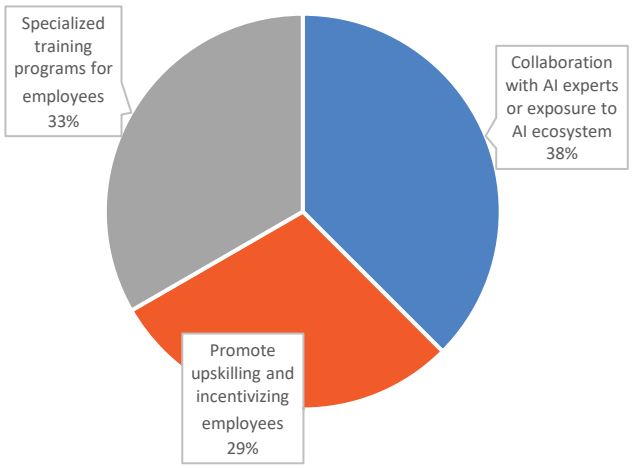


Fig 2.11: Chart representing means to address skill gaps to adopt AI/GenAI

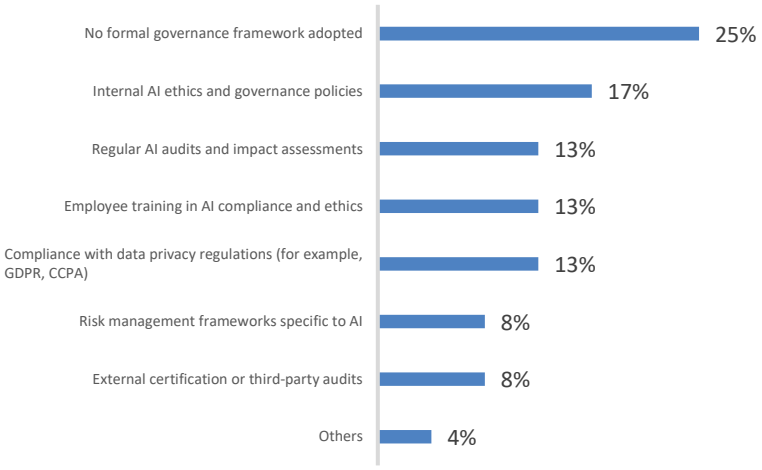


Fig 2.12: Chart representing governance and compliance framework adopted for AI/GenAI deployment

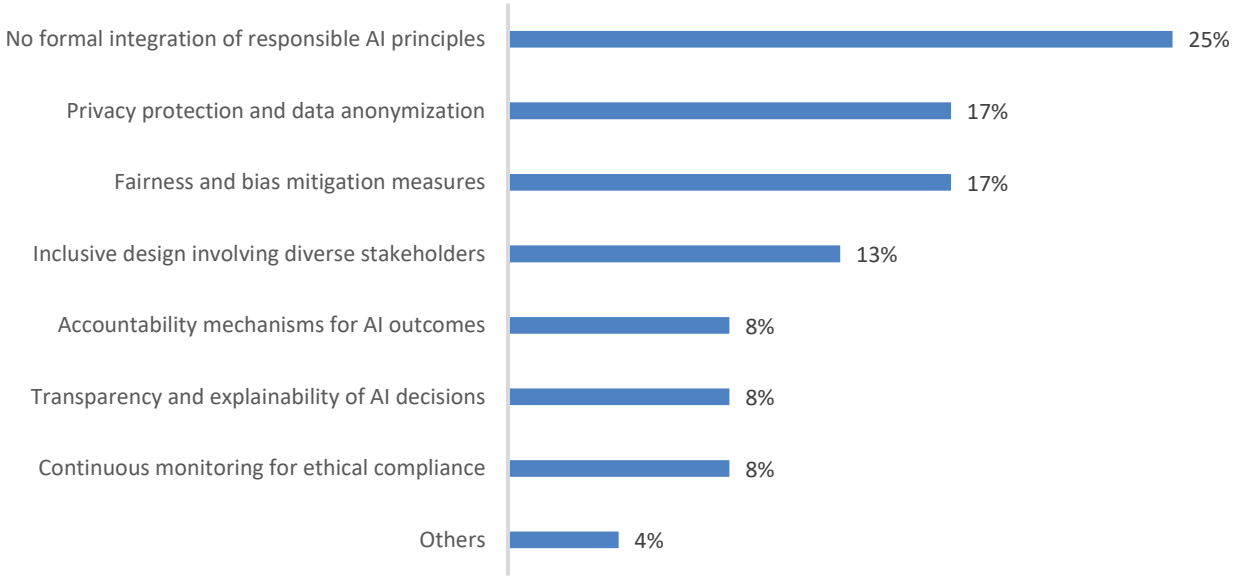


Fig 2.13: Chart representing means to integrate Responsible AI principles into AI/GenAI initiatives

- Finally, the questionnaire invites additional insights on the evolving AI landscape and its implications for IP creation, protection, usage, and commercialization. The responses to this survey will provide valuable perspectives to inform future strategies, policy development, and best practices for harnessing AI in the realm of IP.

Business environment transformation

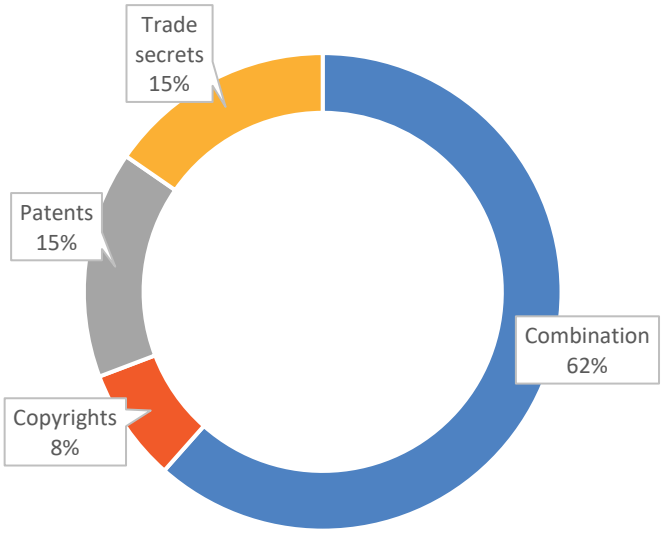


Fig 2.14: Chart representing IPRs for AI/GenAI domain

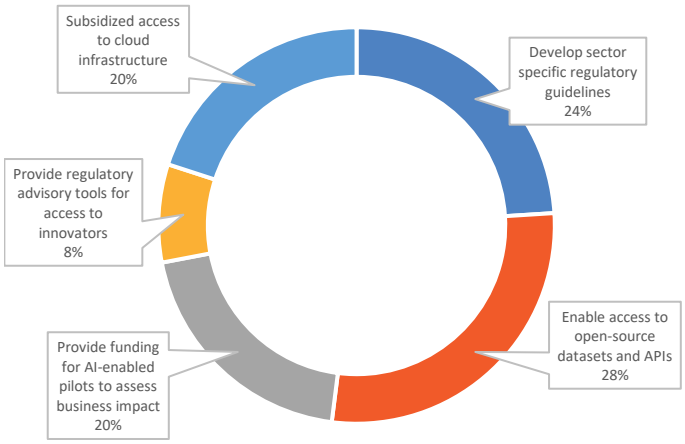


Fig 2.15: Chart representing policy interventions in adoption of AI/GenAI

- The survey collects detailed information regarding organizational demographics, including industry sector, employee count, and core business domain. It then examines the extent and manner of AI adoption for IP management (such as portfolio management, patent search, drafting, and analytics) and business model transformation (including customer experience, process optimization, and predictive analytics).

2.2. Showcasing Indian MSMEs

- The survey captures the viewpoints of Indian MSMEs on the latest advancements in AI, focusing on how AI technologies are being integrated into a variety of core business domains.

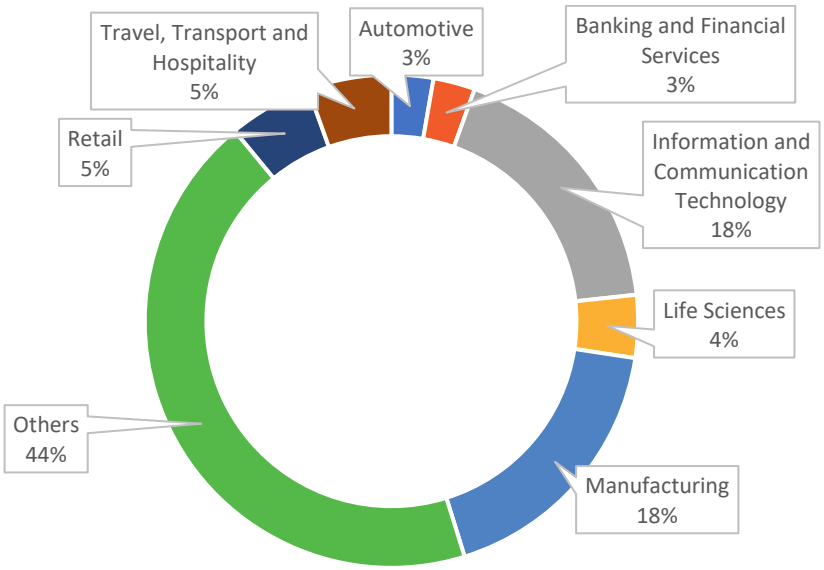


Fig 2.16: Chart representing core business domains of MSME

Business environment transformation

- The findings indicate how Indian MSMEs are utilizing AI-driven services, products, and capabilities—as well as other emerging technologies such as Quantum Computing, Cybersecurity, IoT, Blockchain, Cloud Computing, AR/VR, Digital Twins, and Clean Energy—to support business growth and maintain competitiveness in the marketplace.

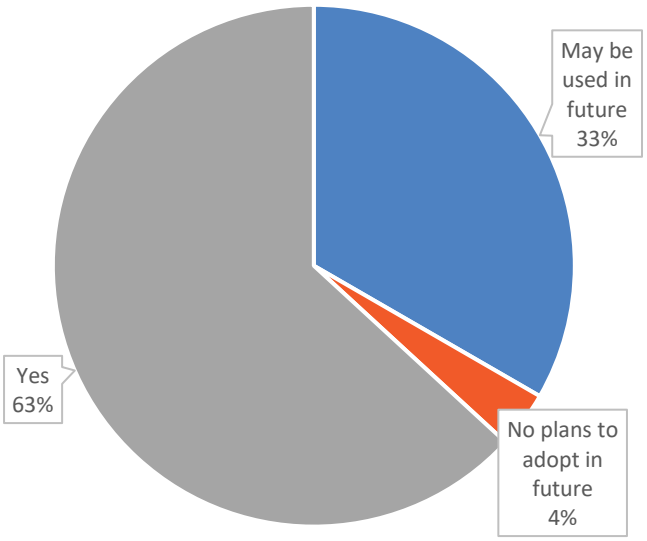


Fig 2.17: Chart representing use of AI-enabled products and services for business

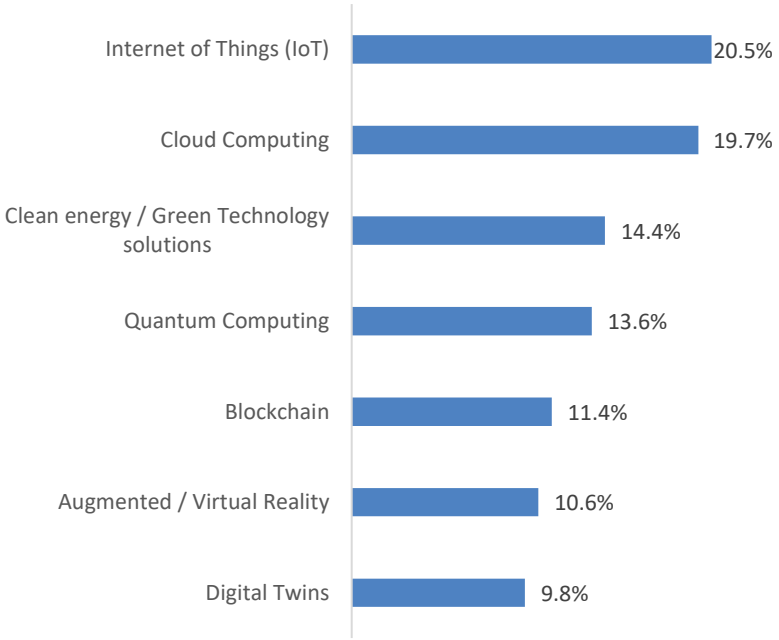


Fig 2.18: Chart representing emerging technologies for AI-enabled business environment

- The findings indicate complexity of implementations, infrastructure, investment capabilities, and other key challenges that organizations encounter when adopting emerging technologies, as illustrated in Fig 2.19.

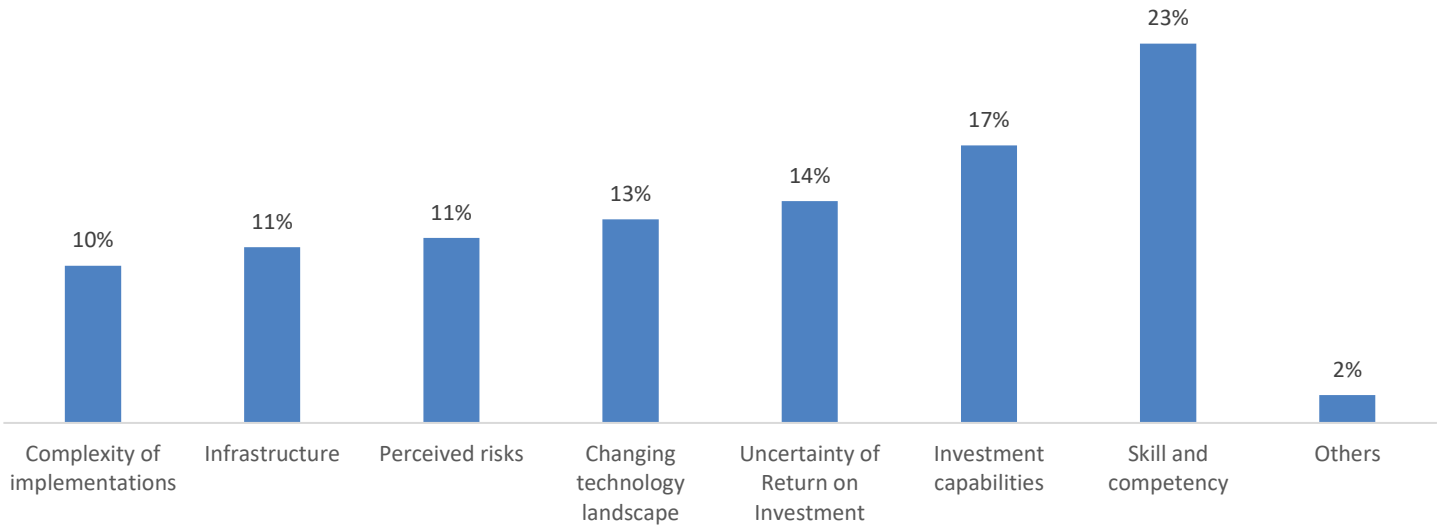


Fig 2.19: Chart representing challenges in adopting emerging technologies

Business environment transformation

Key findings: Challenges in adopting emerging technologies

- **High initial costs:** MSMEs often face financial constraints, making it difficult to invest in and maintain advanced technologies such as AI, Quantum Computing, or Blockchain.
- **Lack of skilled workforce:** There is often a shortage of employees with the necessary expertise to implement and manage emerging technologies, leading to skill gaps that hinder adoption.
- **Data privacy and security concerns:** Adopting technologies such as AI and IoT raises issues related to data privacy, legal compliance, and cybersecurity, which can be particularly challenging for smaller organizations.
- **Regulatory and legal uncertainty:** Ambiguity around regulations, IP rights, and compliance requirements can create hesitation in adopting new technologies.
- **Integration with legacy systems:** MSMEs may struggle to integrate modern solutions with existing, often outdated systems and processes, causing operational disruptions.
- **Infrastructure limitations:** Inadequate digital infrastructure, such as reliable internet connectivity and access to cloud computing, can impede effective technology adoption.
- **Change management and cultural barriers:** Resistance to change within the organization and lack of awareness about the benefits of new technologies can slow down adoption efforts.
- **Ongoing maintenance and support:** Continuous technical support and updates are required to keep emerging technologies functional and secure, which may be challenging for MSMEs with limited resources.

- MSMEs are encouraged to articulate the significance and impact of adopting AI, including the implementation of Small Language Models (SLMs) or Large Language Models (LLMs) where applicable, and to showcase distinguished AI-powered solutions.

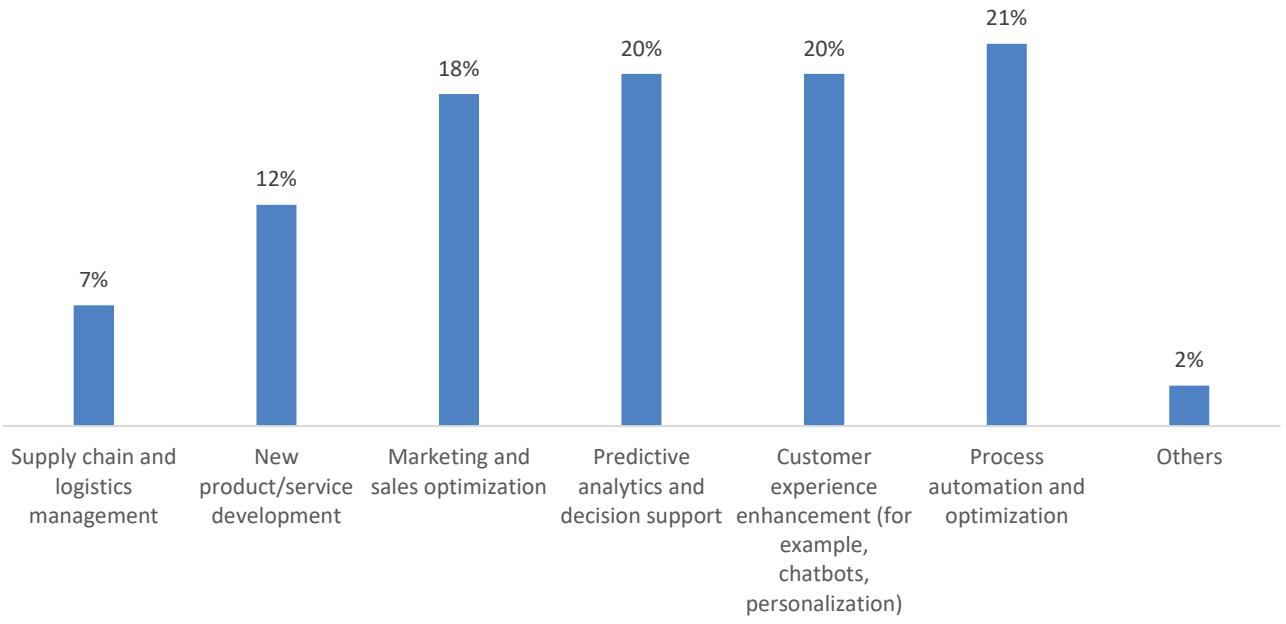


Fig 2.20: Chart representing impact of AI-enabled products and services on overall business

Business environment transformation

- MSMEs face distinct IP challenges in AI and GenAI due to technical complexity, unclear IP ownership, and evolving legal standards. Issues include ambiguous ownership of models and outputs, uncertain patent and copyright eligibility, rapid tech advancement making IP protection difficult, and data privacy concerns. Enforcement is tough and costly, especially with open-source and collaboration models blurring boundaries. Regulatory uncertainty adds to hesitation. MSMEs need clear regulations, legal support, and practical IP strategies to safeguard innovation in this fast-changing field.

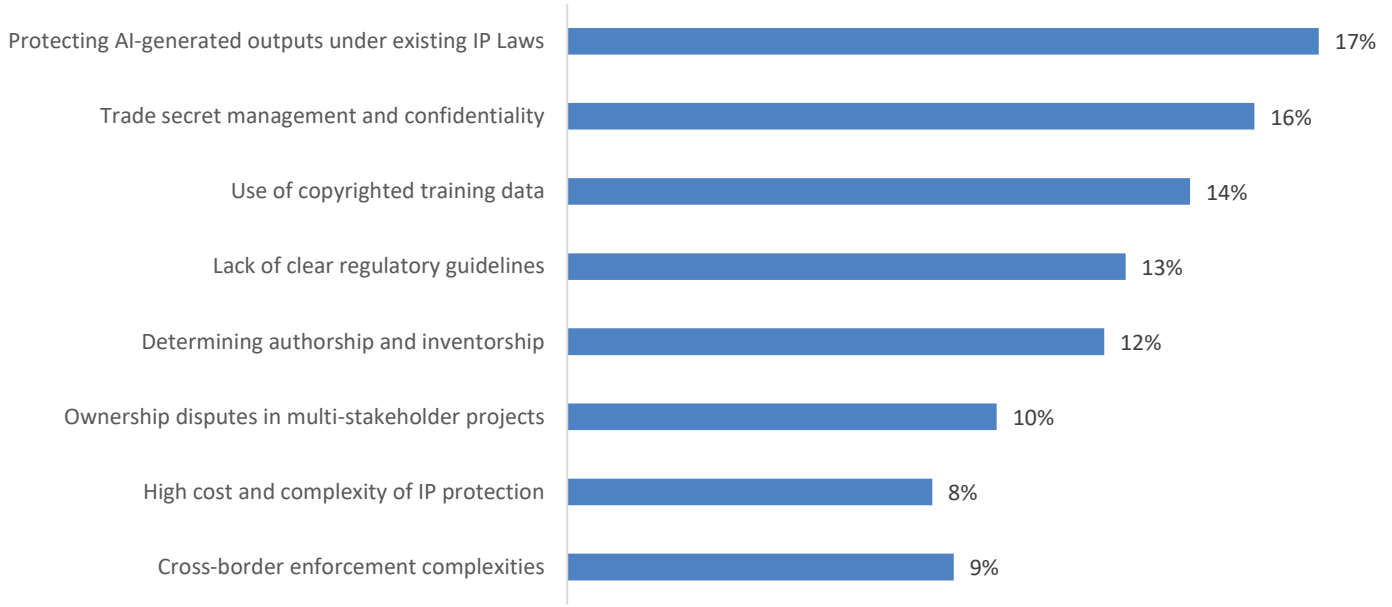


Fig 2.21: Chart representing challenges in creating and protecting IP in AI/GenAI domain

The survey also examines the challenges and risks associated with AI adoption and solicits detailed information regarding the types of support needed—such as policy guidance, infrastructure development, financial resources, or workforce enhancement—to advance further AI integration within the Indian industry.

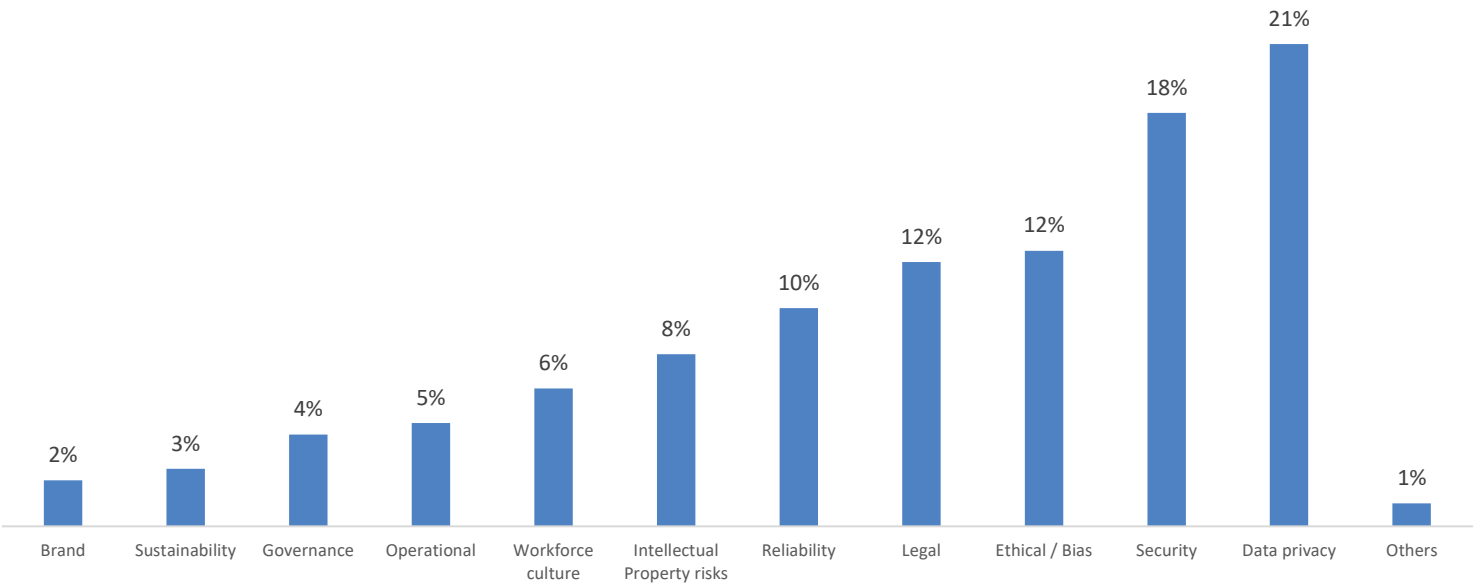


Fig 2.22: Chart representing risks in adopting AI/GenAI

Business environment transformation

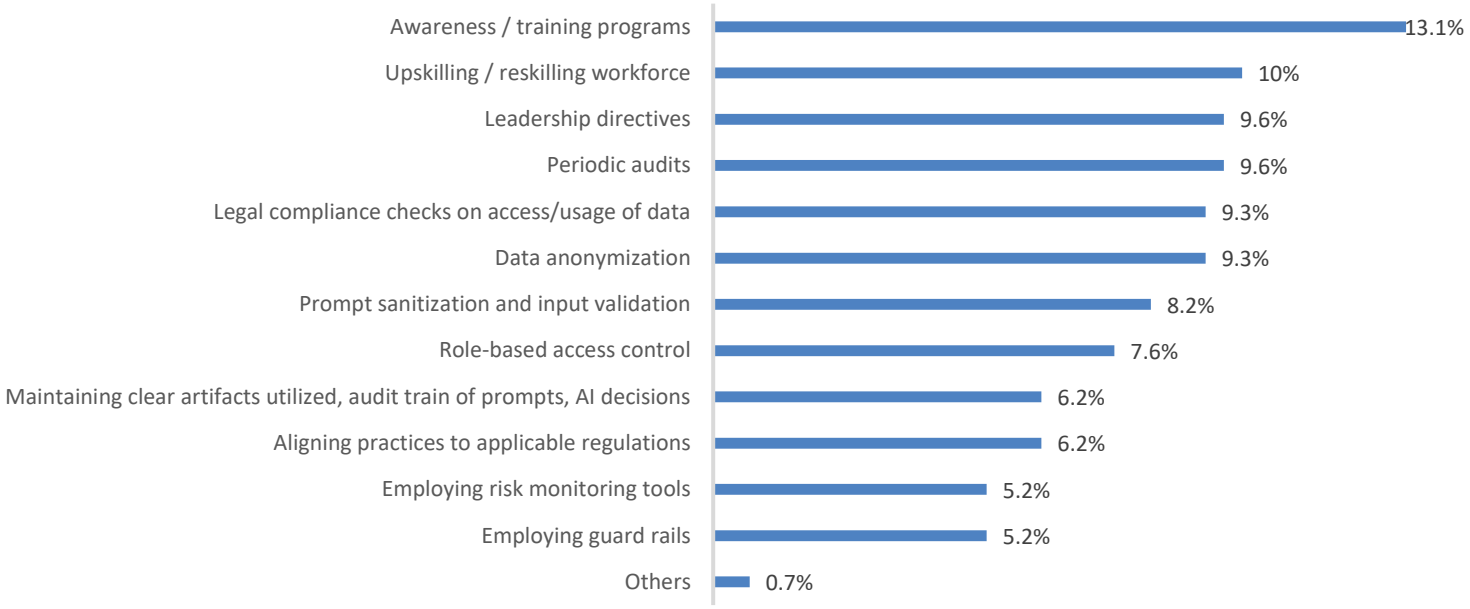


Fig 2.23: Chart representing means to address risks in adopting AI/GenAI

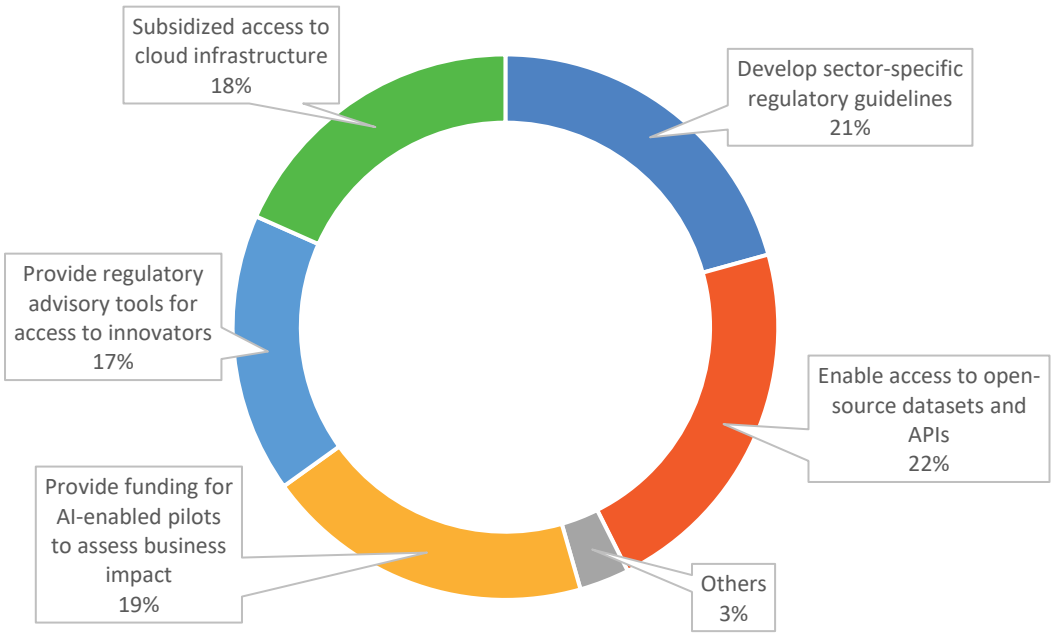


Fig 2.24: Chart representing policy interventions to improve adoption of AI/GenAI technologies

Business environment transformation

Other policy interventions

- Strengthening privacy laws, protecting corporate and individual privacy in all forms including appearance, voice, and personal data. Future security will only apply to personal data.
- Rest of the information worldwide will be generic as AI will have access to everything except your IP and company's IP.
- Access to real-world data for training models to address domain specific problems.
- Stronger legal protection for AI-related IP and algorithms.
- Government incentives and funding for AI adoption in MSMEs and railway sector.
- Clear guidelines for ethical and safe AI use in critical infrastructure.
- Support for building talent pools and skill development in AI.
- Setting out policy interventions that clearly lay down the realistic capabilities and limitations of AI, requiring mandatory human review of decision making and content.

To address skill gaps in AI and GenAI, MSMEs can invest in targeted workforce training, collaborate with educational institutions for upskilling programmes, and leverage online learning platforms to build relevant expertise. Additionally, fostering partnerships with technology providers and consulting experts can help transfer knowledge and best practices, while internal mentorship programmes and continuous professional development can ensure ongoing capability growth. These measures collectively help bridge talent shortages and prepare teams for successful AI adoption.

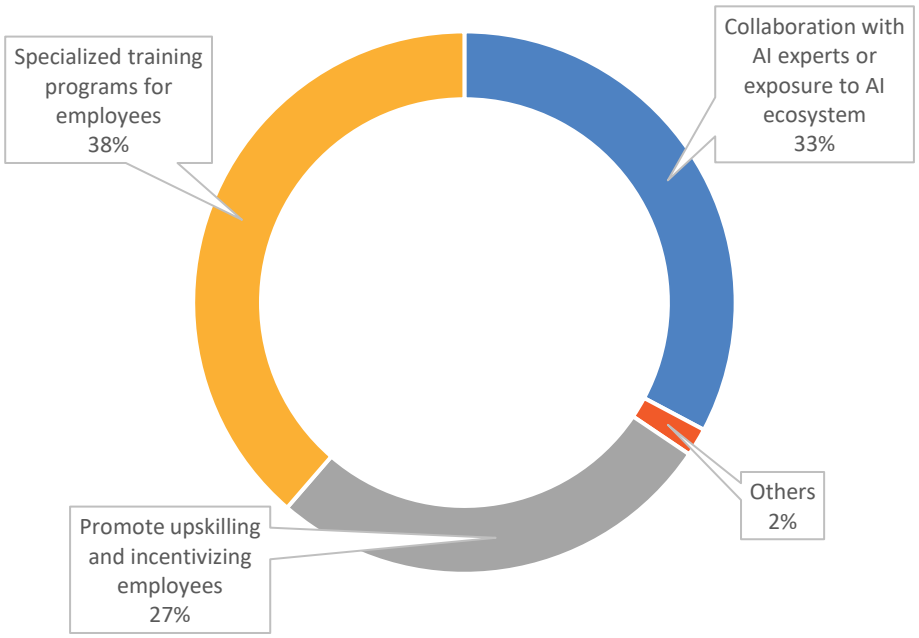


Fig 2.25: Chart representing means to address skill gaps to adopt AI/GenAI

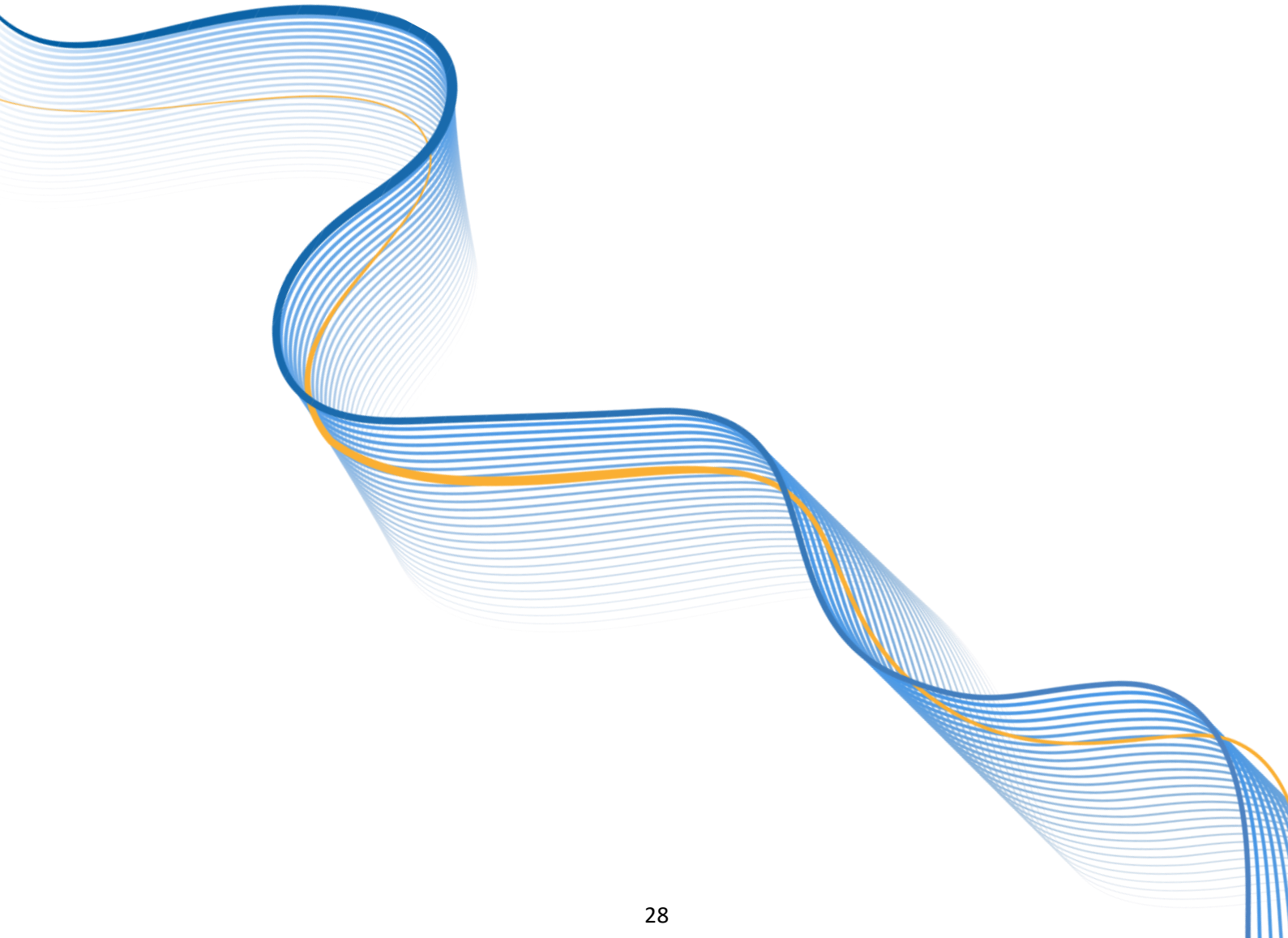
Business environment transformation

2.3. Case studies from MSME

The survey also includes concise case studies to inform its analysis, providing the industry with actionable insights and guidance on advancing AI adoption among Indian MSMEs.

1. **Aethyros Pvt. Ltd**.: Deep-tech startup using AI and blockchain for federated training, logistics, and energy trading; filed 8 patents; challenges in tech complexity and regulation; seeks regulatory sandboxes, infrastructure, funding, and hybrid skills.

2. **Privasapien Technologies**: Specializes in privacy-preserving AI and machine learning; uses advanced tools for compliance and risk management; filed AI-related patents; needs policy clarity, secure infrastructure, funding, and skilled workforce; stresses responsible AI and ethical governance.



Business environment transformation

1 Aethyros Pvt. Ltd

Aethyros Pvt. Ltd. is a deep-tech, patent-holding startup focused on developing next-generation blockchain and AI-powered platforms for societal and enterprise infrastructure. The company is in its early R&D phase, with a turnover of 0–10 lakhs and no commercial revenue yet.

Core focus

AI is foundational, not an add-on, in Aethyros's platforms.

Key applications

- **Federated AI training**: Decentralized model training over blockchain nodes using secure data isolation and smart contracts.
- **Logistics optimization**: AI models optimize delivery paths based on cost, time, and reliability.
- **Energy trading**: Predictive AI enables intelligent renewable energy microgrid trades.

Innovations

- Decentralized federated training platform (blockchain-based).
- Multi-hop blockchain routing for LLM/SLM requests.
- Planned AI-powered policy engine for decentralized ID systems.
- Tokenized compute & GPU marketplace for autonomous AI agent bidding.

Impact of AI adoption

- Eliminates single points of failure.
- Enhances privacy-preserving learning.
- Reduces operational latency in compliance and telecom settlement.

Challenges & risks

- Interdisciplinary complexity (blockchain, AI, compliance).
- Patent-to-product commercialization gap.
- Localization of SLMs/LLMs for Indian languages and regulations.
- Regulatory ambiguity in identity, telecom, and energy sectors.

Support needed

- **Policy:** Regulatory sandboxes for decentralized AI-blockchain projects.
- **Infrastructure:** Access to GPU farms and federated training environments.
- **Funding:** Early-stage IP commercialization grants.
- **Manpower:** Fellowships for hybrid skills in blockchain, LLMs, and secure compute.

Intellectual Property

Aethyros has filed 8 Indian patents in AI and Blockchain, covering:

- Decentralized federated AI training
- Multi-cloud optimization
- AI logistics optimization
- Energy grid optimization
- Telecom call routing
- AI-GPU resource marketplace
- Renewable energy trading
- Decentralized identity authentication

Key message to industry

India should prioritize sovereign, explainable, and privacy-conscious AI infrastructure, moving beyond Western LLMs. Combining AI with decentralized blockchain control is key for trustworthy digital systems. The company urges support for patent-led startups to co-create foundational public platforms.

Business environment transformation

2 Privasapien Technologies Private Limited

Privasapien Technologies specializes in privacy-preserving data innovation, embedding AI at the core of its products and services. Their solutions enable enterprises to extract insights from sensitive data securely and responsibly, using advanced Privacy-Preserving Machine Learning (PPML) techniques such as Federated Learning and Differential Privacy.

AI application & tools

- **Privacy Threat Modelling (PTM)**: Uses AI for predictive analytics and Natural Language Processing (NLP) to proactively identify and mitigate privacy risks.
- **Augmented Data Protection Impact Assessments (DPIAs)**: AI automates regulatory interpretation and risk assessment, reducing compliance analysis time by 60% and privacy audit costs by 40%.
- **Synthetic data generation**: Enables safe innovation and testing while ensuring compliance.
- **Consent & data classification**: Small Language Models (SLMs) streamline consent validation and regulatory reporting.
- **Responsible AI & governance**: Frameworks ensure fairness, transparency, and accountability in AI-driven decision-making.

Business impact

- Accelerated compliance timelines and enhanced data utilization without compromising privacy.
- Improved efficiency, compliance accuracy, and decision-making.
- Strengthened trust among customers and regulators.
- AI is positioned as a strategic driver for business resilience, compliance, and sustainable growth.

Challenges and risks

- Ensuring regulatory compliance while leveraging AI for insights and handling sensitive data across multiple jurisdictions.
- Maintaining transparency, fairness, and explainability in AI outcomes consistently.

These challenges and risks are addressed through Responsible AI frameworks (e.g., AI TRiSM) for accountability and oversight.

Support needed for broader AI adoption in India

- **Policy:** Clear, harmonized regulations and guidelines for Responsible AI and data governance.
- **Infrastructure:** Access to high-performance computing, secure data environments, and collaborative testbeds.
- **Finance:** Grants, subsidies, and funding for AI R&D and deployment.
- **Manpower:** Training programs and industry-academia collaborations to build expertise in AI and privacy engineering.

Intellectual Property

Privasapien has filed patents related to their innovations.

Key message to industry

- Build capability in privacy-preserving AI, governance, and ethics.
- Adopt best practices: privacy/ethics by design, transparent governance, continuous risk assessment, and proactive bias/security mitigation.
- Combine technical skills with ethical oversight for AI as a strategic enabler of innovation, trust, and sustainable growth.
- Follow a phased, structured, and evolving AI strategy aligned with regulatory and business goals.

3

AI patenting trend in India

AI patenting trend in India

The landscape of AI patent trends in India indicates the emergence of inventions in GenAI-led inventions. There is also an emergence of AI agent and agentic AI patents. These inventions reflect a systematic progression in AI-driven innovations designed to automate complex processes, enhance decision-making capabilities, and tailor customer experiences.

3.1. AI patent trends

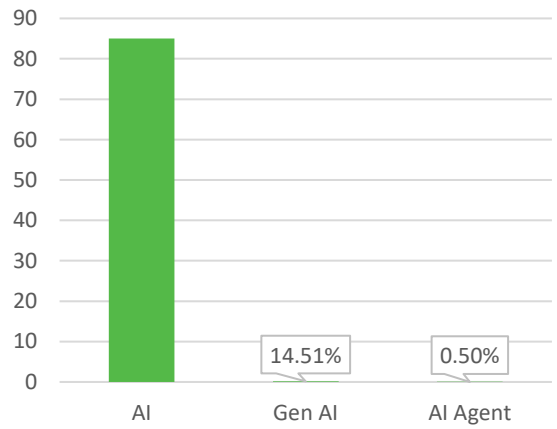


Fig 3.1: Innovation timeline of AI patents since 2019

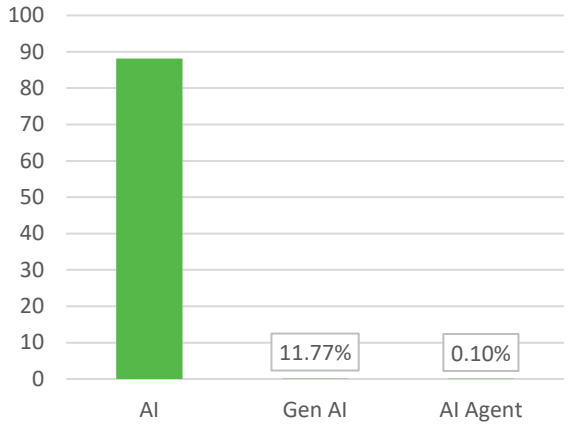


Fig 3.2: Innovation timeline of AI patents from 2010-2018

Table 3.1: AI patent statistics in various timelines

Technical domain	Total patents filed 2019-2025	Contribution%	Total patents filed 2010-2018	Contribution%
AI	83059	84.99	3931	88.13
GenAI	12058	14.51%	463	11.77%
AI Agent	397	0.50%	4	0.10%

Key findings: Artificial Intelligence (AI) patent filings over the past 15 years

- AI patent filings in India surged significantly after 2018, with 83,059 patents filed between 2019 and 2025 as shown in Fig 3.1 compared to 3,931 from 2010 to 2018 as shown in Fig 3.2.
- The top ten patent applicants were Samsung Electronic, Chandigarh University, Jain Deemed to be University, Qualcomm Inc, Galgotias University, Teerthanker Mahaveer University, Lovely Professional University, Sanskriti University, Tata Consultancy Service Ltd, and Chandigarh Group of Colleges.
- Generative AI patents constitute 14.51% of recent filings, whereas AI Agent patents are still nascent with 498 applications. A steady increase has been observed in patent applications filed by domestic applicants, rising from 53% in 2019 to 82% in 2024.
- Currently, 13% of AI applications have been granted, with grant rates soaring from 0.7% in 2019 to 32% in 2024, signaling strong momentum in AI innovation and adoption.

AI patenting trend in India

The methodology utilized for identifying AI patents draws upon data obtained from Proprietary Patent Databases as of June 2025, encompassing the years 2019 to 2025. This approach combines International Patent Classification (IPC) codes with a carefully selected set of AI-related keywords, sourced from academic literature, web resources, and reputable reports such as those issued by WIPO. Search queries were systematically crafted and iteratively refined through manual sampling to maximize relevance and accuracy. The analysis is limited to patents filed within the jurisdiction of India, as delineated in the proprietary databases. Additionally, the mapping of patents to specific technological or application domains is non-exclusive, permitting individual patents to be linked to multiple domains according to their content and significance.

3.2. GenAI patent filing trends

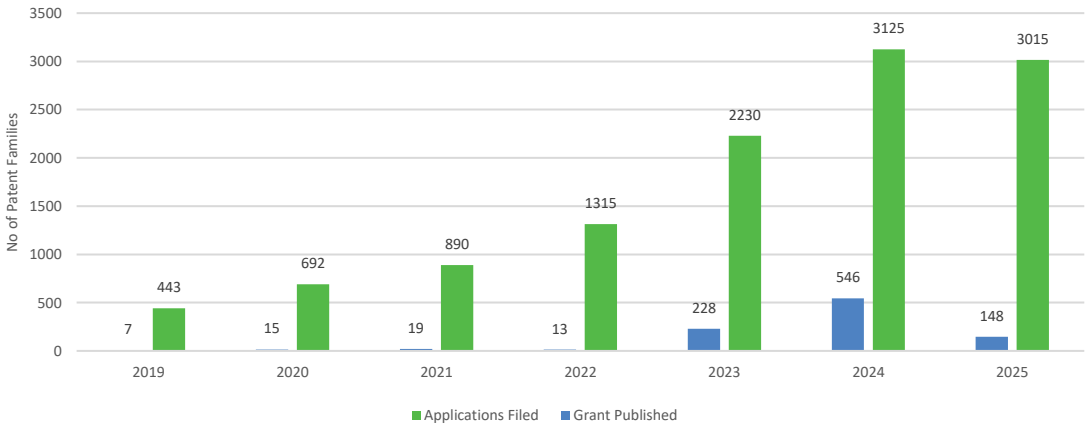


Fig 3.3: Patenting trend of the GenAI patents

Table 3.2: Patent statistics of IPC classification of GenAI-led inventions in 2019 and 2025

Top Technical Field Classification (IPC) in 2019	Top Technical Field Classification (IPC) in 2025
Information retrieval & databases: Top IPC classification G06F17/30 focuses on efficient information retrieval and database structures with 31 filed patents.	**Dominance of Machine Learning (ML):** Machine learning patents led with 1244 filings, highlighting AI's explosive growth in innovation.
Digital computing innovations: Classification G06F17/00 encompasses digital computing equipment and methods tailored for specialized functions, with 20 patents.	**Emerging healthcare technologies:** Healthcare AI patents surged, especially in computer-aided diagnosis and diagnostic measuring technologies. IPC G16H50/20, A61B5/00 and G16H10/60 cover 434,326 and 254 patents respectively.
Natural Language Processing (NLP): IPC classes G06F17/27 and G10L15/22 cover parsing, and speech recognition, reflecting advances in human-computer interaction.	**Advances in semantic analysis:** Semantic analysis patents increased, reflecting the need for systems that interpret data meaning effectively. IPC G06F40/30 encloses 590 patents.
Early AI and e-commerce tech: Emerging AI applications and e-commerce technology are represented by classes G06N99/00 and G06Q30/00 with several patents each.	**Focus on cybersecurity:** Network security protocols gained importance with H04L9/40 comprising 279 patents, underscoring cybersecurity's critical role.

AI patenting trend in India

Key findings: Patent volume and evolution of patent trends

- The total number of patents filed on GenAI models between 2019 to 2025 is 12295 (refer Fig 3.3). The largest family size patents have been on AI Assistants that use NLP, followed by patents in medical application that use deep learning-based techniques.
- Early patent filing focused on the implementation of basic functions of any operation such as complex mathematical operations, handling natural language data (speech analysis or synthesis), or automatic analysis. For example, parsing, data acquisition and logging, details of database functions independent of the retrieved data types. While in 2025, we see GenAI-led inventions being filed in areas such as machine learning, learning methods, semantic analysis, combination of network, computer-aided diagnosis, measuring for diagnosis purposes, network security protocol, patient-specific data, education, input and output arrangements for interactions between user and computer as mentioned in Table 3.2.

Table 3.3: Trends in GenAI-led inventions in NLP

2019	2025
Natural language queries	Personalized learning
Natural language response	User interaction
Speech inputs	Real time voice inputs
Language processing techniques	Personalized recommendations
Data analysis	Speech recognitions
Text analysis	Predictive analytics
Training data	Multilingual support
Machine learning techniques	Emotional state analysis

Key findings: Evolution of AI systems

- AI systems moved from basic input/output to real-time, personalized, and emotionally aware interactions. In 2019, GenAI patents related to natural language primarily focused on natural language queries, language processing techniques, and data analysis. By 2025, the field of Natural Language Processing (NLP) has expanded considerably, with an increased number of patents covering applications such as personalized recommendations, speech recognition, predictive analytics, and user engagement as shown in Table 3.3. Machine learning and NLP are now deeply embedded in user-facing applications. The evolution of speech-related patents can be further associated with virtual assistants amounting approximately to 20 in 2019; rising to 245 patents concerning AI assistants by mid-2025, reflecting the growth driven by advancements in user interactivity.

AI patenting trend in India

3.2.1. Patenting trend of major GenAI models, modes, and subject matter of patents between 2019 and 2025

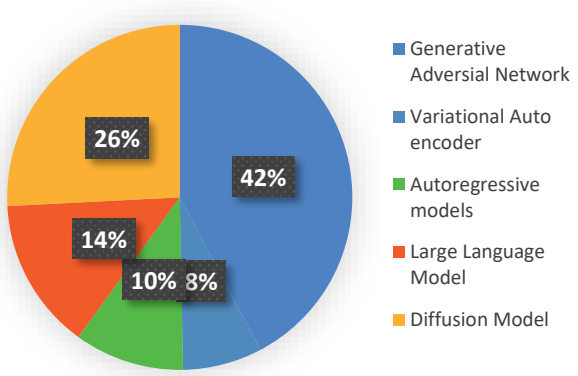


Fig 3.4: Patent distribution of major GenAI models

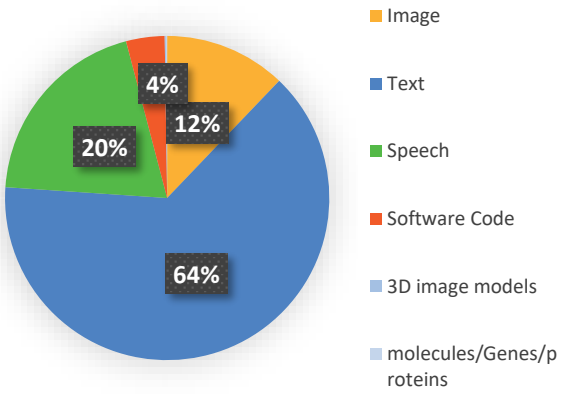


Fig 3.5: Patent distribution of major GenAI modes

Table 3.4: Patenting trend of GenAI models with emphasis on subject domain

GenAI models	Patent overview and application
Generative Adversarial Network	• A total of 2,103 GAN-related patents have been filed, with 16% granted. • 217 patents focus on data augmentation, improving AI training datasets. 197 patents cover anomaly detection and identifying irregularities in data, GANs used for synthetic data creation (185 patents) and realistic image generation (129 patents).
Variational autoencoder	• Variational autoencoders (VAEs) are powerful deep learning models with increasing applications in medical imaging and healthcare. There are nearly 279 applications in VAE with 25% granted patents. • They excel at generating synthetic medical images (23 patents), augmenting datasets (36 patents), and detecting anomalies (51 patents).
Autoregressive models	• There are 512 patents related to autoregressive models, with 21% granted and the rest pending applications. • Autoregressive models are mainly used for time series forecasting (147 patents), sentiment analysis (58 patents), and financial forecasting (28 patents). • These models excel at predicting trends and behaviors by modeling sequential data for decision-making support.
Large Language Model (LLM)	• LLMs have 707 patents with only 12% granted, indicating many are still under review or in early stages. • LLMs are applied across conversational AI (23 patents), healthcare (23 patents), sentiment analysis (80 patents), speech recognition (87 patents), agentic AI (9 patents), and software development (32 patents). • The wide range of patents highlight LLMs' potential to revolutionize industries with human-like text understanding and generation.
Diffusion Model	• Diffusion models follow with 1,285 patents, among which 24% of the patents are granted. • The most important application of diffusion models is image and video generation, particularly image recognition devices (449 patents), mobile application (90 patents), medical image (54 patents), and AI chatbots (8 patents).

AI patenting trend in India

Key findings: Increase in patent filings under GANs and LLMs

- Among the core models of GenAI, a significant number of patent families fall under generative adversarial networks (GANs), accounting for approximately 42% of GenAI models as shown in Fig 3.4. These models, which have experienced notable growth since 2019, utilize a generator and a discriminator to produce outputs such as images and videos.
- Following the development of models such as ChatGPT, LLMs have shown considerable increase in patent filings, especially in areas such as text generation and summarization.
- GenAI models employ various types and modes of input and output data, such as text, image/video, and voice. A large portion of GenAI patents in India are related to text data, indicating activity in the development of language models and text processing technologies, with text-based patents making up nearly 64% of GenAI patents. Patents concerning speech, sound, and music account for about 20% of GenAI patents in India. Image-based GenAI patent applications represent another area of interest. Patent families in other modes, such as 3D image models and molecules/genes, constitute less than 1% as shown in Fig 3.5.

3.3. AI agent patenting trends

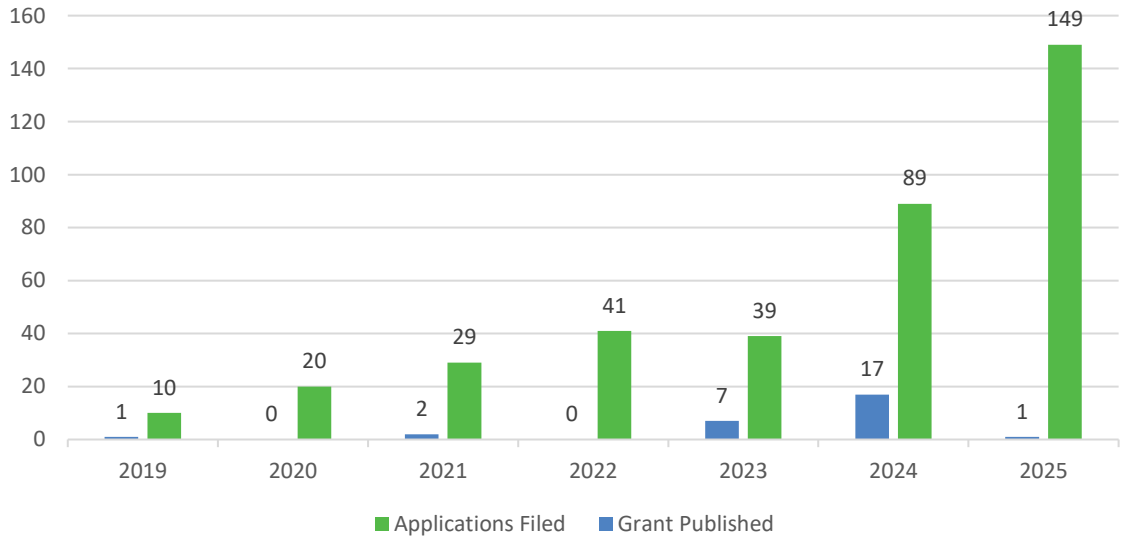


Fig 3.6: Patenting trend of AI agent patents

Key findings: Growing focus on AI agents

- The filing in AI Agent-based patents has seen a double fold increase since 2024 as shown in Fig 3.6. Early applications in AI agents were majorly based on reinforcement learning techniques to achieve a particular target. Through the years, interaction between multiple AI assistants and users has been higher followed by autonomous learning.
- Early applications in AI Agent patents were on autonomous delivery systems, human activity prediction, performing a task or action based on voice and voice assistance. Whereas patents in 2025 were more on multi-agentic systems, workflow automation, AI Assistants, conversational agents, regulatory compliance, resource allocation, business intelligence, predictive analytics, risk management involving edge computing, cloud infrastructure, web, and mobile applications.
- The development of AI Agent models, designed to autonomously perceive environments, process data, and take actions to achieve specific goals, is a growing area of innovation in India. While specific data on "AI Agent model" patenting trends in India is limited, the six most popular language models that are used in AI agents have been analyzed and shown in Fig 3.7.

AI patenting trend in India

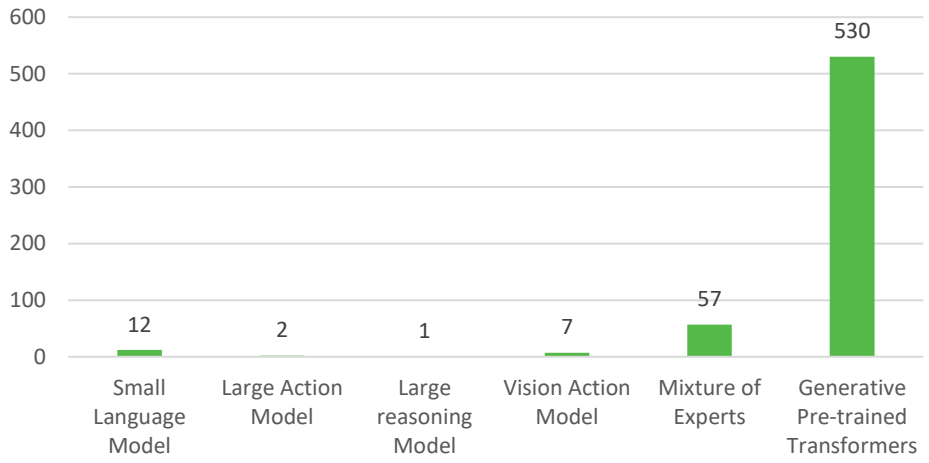


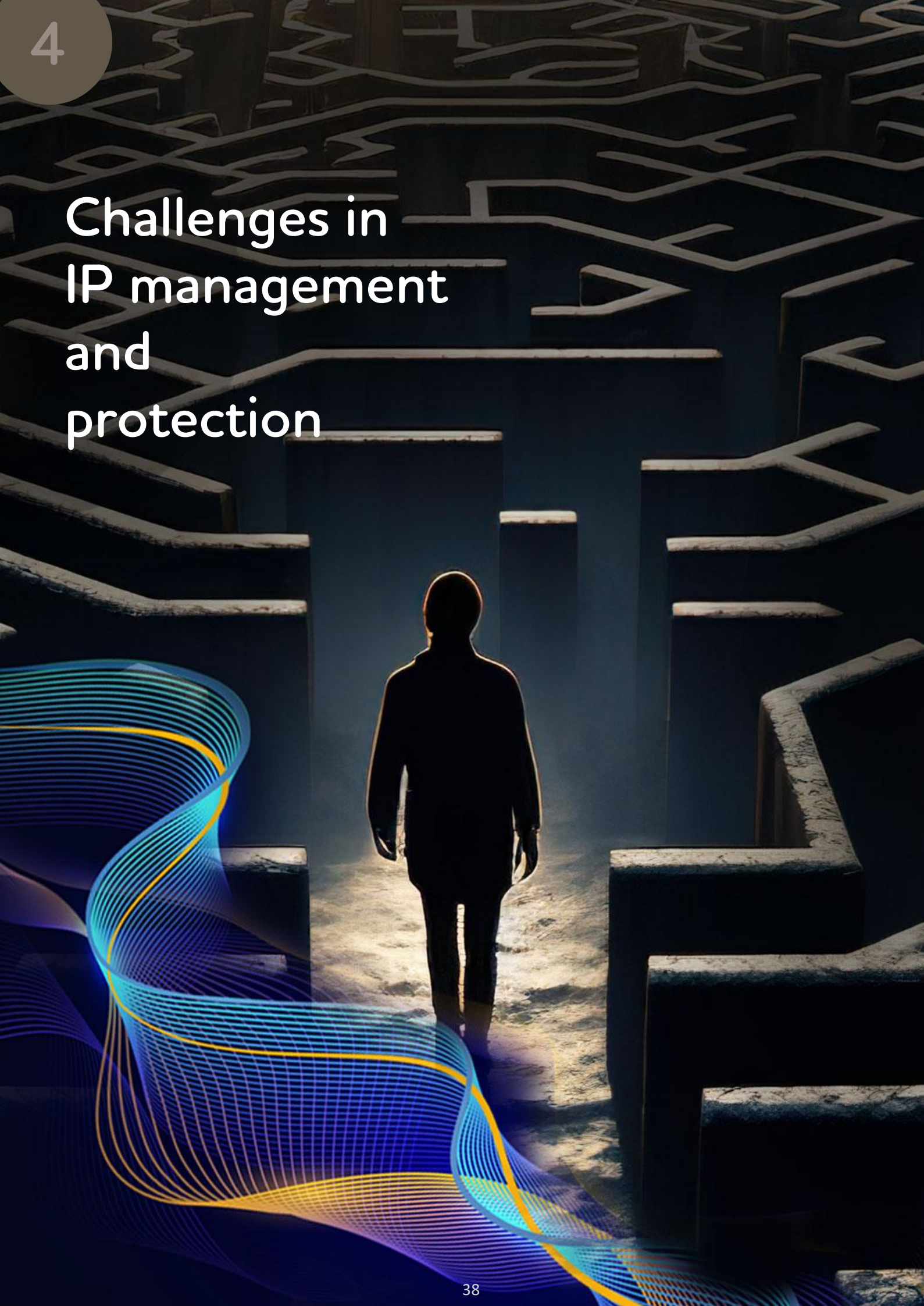
Fig 3.7: Most popular models used in AI agents

Key findings: Other popular models

- The General Pretrained Transformer's functional application includes predicting words to generate fluent text, question-answer techniques, chat, and perform actions through prompts. The dominant technical fields are semantic analysis (G06F40/30) followed by machine learning algorithms (G06N20/00), procedures during speech recognition process (G10L15/22), and chatbot-generated messages (H04L51/02). The models can be applied to sentiment analysis (150 patents), social media (109 patents), healthcare (16 patents), customer service (68 patents), and education (39 patents).
- The Large Reasoning Models perform multistep reasoning and planning for more consistent, explainable responses. The existing patent majorly focuses on context-aware reasoning memory framework management.
- Vision Language Action (VLA) models represent a groundbreaking advancement in AI, especially in the field of robotics and embodied AI. They integrate three core modalities—visual perception, natural language understanding, and action generation—into a single, unified framework. VLA has its implementation in robotics providing visual interpretation, NLP, and physical action execution. The term mostly used in the patents is Embodied AI. Apart from robotics, the field involves telesurgery (A61B34/35) and target aiming in gaming (A63B63/00) where patents have been filed.
- Small Language Models (SLMs) are a type of AI model for NLP tasks. They are smaller and more efficient than LLMs. SLMs are designed to be cost-effective and work in environments with limited resources. The number of applications filed has been constantly increasing over the years. The application areas of SLM involve diagnostic purposes (A61B5/00); semantic analysis (G06F40/30); resources, workflows, human, or project management (G06Q10/06), special-purpose networking environments such as medical networks, sensor networks (H04L67/12), banking (G06Q40/02), education (G06Q50/20), and speech processing (G10L15/22).
- Mixture of Experts (MoE) is a machine learning technique that uses multiple specialized sub-models, called "experts", to divide a problem space into regions. Each expert specializes in a different subset of the input data to jointly perform a task. The MoE technique addresses the computational demands of large models by breaking them into smaller, specialized networks. The application concentrates highly on sensor data specifically on computer aided diagnostics (A61B5/00).
- AI agent models offer tremendous potential to advance machine learning in real-world scenarios. However, unlocking their full capabilities requires overcoming several critical challenges.

4

Challenges in IP management and protection



Challenges in IP management and protection

The rapid rise of AI has transformed innovation, with benefits transcending sectors and geographical boundaries. However, the adoption of AI technology poses significant IP management challenges particularly pertaining to patents, copyrights, and trademarks. These Intellectual Property Rights (IPR) have been strained primarily by questions around inventorship, ownership, and infringement amongst others.

4.1 Legal precedents and industry impact

This section examines some pivotal decisions that translate legal precedents to boardrooms and have been instrumental in providing guidance to navigate the evolving Artificial Intelligence-Intellectual Property (AI-IP) landscape. Table 4.1 highlights these decisions followed by analysis of the impact each of these decisions have on business and industry at large.

Table 4.1: Summary of key legal decisions shaping AI and IP, with insights on their impact on business and industry

Challenges	Case Law(s) shaping the jurisprudence	Background
Inventorship challenges in AI inventions: AI cannot be an inventor	Thaler v. Vidal	Dr. Stephen Thaler developed an AI system named Device for the Autonomous Bootstrapping of Unified Sentience (DABUS); it was claimed that the AI system created inventions. Patent applications were filed naming DABUS as the inventor at IPO, USPTO, EPO, UKIPO, IP Australia, and South Africa among others.
Patent Eligibility of AI inventions: Invalidated as abstract ideas	Recentive Analytics, Inc. v. Fox Corp.	Four patents directed to the use of machine learning for the generation of network maps and schedules for television broadcasts and live events were affirmed to have patent ineligible subject matter. Accordingly, the infringement case filed by Recentive Analytics, Inc., the owner of the four patents, against Fox Corp., Fox Broadcasting Company, LLC, and Fox Sports Productions, LLC for infringement was dismissed.
Patent infringement / invalidation: Mere application of AI is not patentable	AliveCor v. Apple	AliveCor, a medical device and AI company sold a heart-rate monitoring wearable for Apple watches until Apple incorporated its own ECG capabilities with a new Apple watch series and made the iOS operating system incompatible with the AliveCor's wearable to impede competition. AliveCor accused Apple of infringing three patents related to AliveCor's wearable and in parallel, sought a ban on Apple Watch imports at the U.S. International Trade Commission (ITC) in 2021. However, the three challenged patents of AliveCor were rendered obvious in view of prior art references provided by Apple and knowledge of a person of ordinary skill.

Challenges in IP management and protection

Challenges	Case Law(s) shaping the jurisprudence	Background
Copyright challenges: AI training-Copyright infringement claims dropped	Getty Images v. Stability AI	Getty Images, a media company that stores and supplies visual and digital media content sued Stability AI, the developer of a model called Stable Diffusion which generates synthetic images from both written and image prompts. Getty Images claimed that Stability AI infringed multiple IPRs. Main claims: Copyright infringement related to the use of copyrighted content as input to train AI model and database right infringement on the stance that a substantial part of its database of images was 'extracted' in the creation of the AI model. Again, copyright infringement considering some of the output images by the AI model are similar to the input images. A secondary claim being currently pursued is copyright infringement by the AI model itself as an 'article'.
Copyright challenges: Fair use in AI training	Bartz v. Anthropic, Kadrey v. Meta Platforms, Inc.,	Whether the use of copyrighted works for training GenAI models is copyright infringement was discussed considering the provision of fair use provided under Section 107 of the US Copyright Act.
Copyright challenges: Fair use of news content in AI training	The New York Times v. OpenAI and Microsoft, ANI Media Pvt.Ltd. v OpenAI and Anr	Both lawsuits allege that copyrighted news content was used to train AI models without permission or compensation.
Copyright challenges: Copyrightability of AI generated work-AI cannot be an author	Zarya of the Dawn	Zarya of the Dawn is a graphic novel whose copyright status was examined by the U.S. Copyright Office (USCO) after some images in the novel were created with the help of the AI image generator Midjourney.
Copyright challenges: AI generated actor-AI training	Union intervention and contract protections: The SAG-AFTRA issued a statement condemning the use of "synthetic performers" like Tilly Norwood.	Tilly Norwood is a hyper-realistic, AI-generated "actor". The Screen Actors Guild–American Federation of Television and Radio Artists (SAG-AFTRA) publicly denounced Norwood, stating she was "trained on the work of countless professional performers—without permission or compensation". Real-life actors have also claimed that their likeness and mannerisms were used without consent.
Trademark challenges: Passing off	Getty Images v. Stability AI	Trademark infringement over the reproduction of Getty's watermark in some of the AI-generated images and passing off on grounds that the use of its branding could mislead consumers are amongst the secondary claims currently being pursued by Getty Images.
Trademark challenges: Misuse of Trademark	Snapdeal v. Snapdeal lucky draws	The fraudulent "Snapdeal Lucky Draw" scam exploited customer trust of the legitimate Snapdeal brand.
Trademark challenges: Deepfakes, voice cloning, and IP misuse	Sadhguru v. Unknown Anil Kapoor v. Simply Life India Asha Bhosle v. Mayk Inc.	The lawsuit addressed the misuse of a person's identity, including his image, voice, and unique mannerisms, through AI and deepfake technology.

Challenges in IP management and protection

Challenges	Case Law(s) shaping the jurisprudence	Background
Patentability challenges: Violation of patent laws that serve as a critical safeguard against the patenting of inventions that could harm public health, safety, or the environment.	Institutional Review Board (IRB) approval to protect the rights and welfare of humans participating as subjects in research studies	IRB approval signifies that the research meets ethical and regulatory standards, protecting human participants from harm and ensuring they provide informed consent.

4.1.1. Inventorship challenges

a) Current jurisprudence
- Barring South Africa, all other jurisdictions have unanimously agreed that only a human can be considered as an Inventor.

b) Courtroom to boardroom
- To invest in Research and Development (R&D) particularly in the Artificial Superintelligence (ASI) space, there would always be a potential concern on how such inventions can be protected.
- Companies may incur additional costs in adopting multiple approaches depending on the prevailing law in each jurisdiction of business interest considering the inconsistency in assigning inventorship to AI systems.
- IP portfolios that include AI-generated assets may face challenges in valuation when licensing or during Mergers and Acquisitions (M&A) considering enforceability concerns.

4.1.2. Patent eligibility challenges

a) Current jurisprudence
- Routine implementation of known technology that merely enhance speed and efficiency of human executable tasks do not render the methods patent eligible.

b) Courtroom to boardroom
- Patents directed to mere application without concrete improvements in technology are vulnerable to invalidation.
- Patent owners risk losing business that capitalizes such patents, if invalidated.
- Potential infringing companies risk losing business and credibility in the market if the infringement is established.
- Valuations of patent portfolios centered around such patents may also be affected.

Challenges in IP management and protection

4.1.3. Patent infringement/invalidation challenges

a) Current jurisprudence
- Extending general ML techniques to specific application of ML is considered obvious, particularly if there is no claim for a specific ML algorithm.

b) Courtroom to boardroom
- Application of AI alone does not make inventions patentable. It is important to claim non-obvious technology leap and not merely application of technology in an expected manner.
- Invalidation of patents weakens the organization's IP portfolio, may impact investor confidence and impacts its capacity to monetize patent rights.
- Continued litigation implies increased legal costs and a looming sense of strategic uncertainty.

4.1.4. Copyright challenges

AI training-copyright infringement claims dropped

a) Current jurisprudence
- The main claims were dropped considering the challenge in establishing infringement as the AI model was trained in the US, rendering UK copyright law inapplicable.
- The AI model was provided with an "image strength" setting that defined how much the generated images resembled the input copyrighted work in response to a user's text or image prompt. The defense was that copyright infringement, if any, is based on user action (use of the "image strength" setting) and not that of the AI model owner. Further, defense was that some of the input work lacked title and hence there was no copyright infringement.
- The secondary claim whether an AI model can be an "infringing article" is still under discussion.

b) Courtroom to boardroom
- Location of training of AI models is an important consideration to be accounted for by businesses to hold their own against businesses employing GenAI in ways that may hamper their business.
- From AI developers' point of view, even models trained legally abroad could face liability if offered in jurisdictions with strict IP regimes.
- Both AI developers and AI users need to be cognizant of the capabilities of the AI model that may cause a user to perform potentially infringing actions and accordingly the liability considerations.
- Whether an AI model can be an "infringing article" and its deployment into a jurisdiction with strict IP regime constitutes secondary infringement will affect AI developers and business entities which import AI models and related content into such jurisdictions.

Fair use in AI training

a) Current jurisprudence
- Transformative use seems to be the key to the fair use doctrine in AI.
- Additionally, an important aspect to assess fair use is how the use impacts the market value or potential market for the original works.

b) Courtroom to boardroom
- AI companies must pay for or properly license the data they use for training.
- Using pirated content, even for training, carries significant liability.
- AI developers remain vulnerable in future litigation and a constant watch for impact of the AI output in the form of evidence of market harm or producing infringing outputs is critical to adhere to the fair use doctrine.

Challenges in IP management and protection

“Fair use” of news content in AI training

a) Current jurisprudence
- Copyright infringement claims of unlawfully storing, using, and reproducing copyrighted news content to train its LLMs is being pursued.
- The complaint also raises concerns about AI "hallucinations" that attribute false information to news content owners and thereby potentially harm its reputation.
- Delhi High Court has directed OpenAI to indefinitely save a broad range of user interaction data to prevent the destruction of potential evidence for discovery purposes.

b) Courtroom to boardroom
- Established risk of AI training bypassing the paywall of the source data provider and depriving it of subscription and advertising revenue.
- Wrongly attributed fabricated news and interviews can damage an organization’s reputation.
- Physical presence of the organization and/or AI servers in the jurisdiction of infringement needs utmost attention to establish infringement as seen in several case laws.
- As courts worldwide continue to expand copyright protection principles to address the unique challenges posed by the AI era, organizations developing AI systems must remain mindful of their user privacy obligations and commitments made to Application Programming Interface (API) customers regarding data deletion, given the potential risks of infringement that may not yet be fully anticipated.

Copyrightability of AI generated work-AI cannot be an author

a) Current jurisprudence
- The United States Copyright office (USCO) ruled that only the human-authored portions of the novel, such as text and arrangement, were eligible for copyright.
- The AI-generated images were excluded from copyright protection because they lacked substantial human authorship. Prompts by the author to the AI model for generating images do not exercise sufficient creative control over the final AI-generated images, making them suggestions rather than dictated results.

b) Courtroom to boardroom
- Assess commercial risk in investing in purely AI-generated art, music, or text that will offer no guarantee of exclusive ownership or IP protection.
- Organizations must track and mandatorily disclose AI usage in their work to avoid copyright registration cancellation.

AI generated actor-AI training

a) Current jurisprudence
- The creation of an AI generated actor trained on thousands of copyrighted films and performances raises the legal question of whether its new output is truly original or an infringing derivative work.
- Copyright infringement or fair use dilemma continues since there is no clarity on whether the AI output is truly "transformative" if it closely mimics or competes with human-created work. Adding to the other aspect established by recent case laws on how the use of synthetic actors impacts the market value or potential market of human actors.

b) Courtroom to boardroom
- Erosion of trust and value of organizations dealing with AI generated actors.
- Moral responsibility on organizations that may cause a threat to livelihood of human actors.

Challenges in IP management and protection

4.1.5. Trademark challenges

Passing off

a) Current jurisprudence
- The passing off claim is being pursued.

b) Courtroom to boardroom
- The potential for AI to generate output that may infringe IPRs of others including trademarks underscores the risk to brand reputation and market perception.

Misuse of trademark

a) Current jurisprudence
- The Delhi High Court granted plaintiff relief by directing the blocking of specific fraudulent websites that were infringing on its trademark.
- A "blanket" injunction to restrain domain registrars from registering any future domain names containing the trademark of the plaintiff was refused.

b) Courtroom to boardroom
- Despite legal victory against the fraudulent website, the underlying issue persists due to the difficulty of shutting down every new fraudulent site.
- Heavy financial and operational burden imposed on businesses to protect their brand and consumers because of the need to invest in continuous brand monitoring and legal action.

Deepfakes, voice cloning, and IP misuse

a) Current jurisprudence
- The Delhi High Court affirmed AI-generated deepfakes and other digital impersonations are actionable infringements.
- The Bombay High Court held that AI voice cloning constitutes infringement.
- Commercial exploitation through sale of merchandise without consent is unlawful.

b) Courtroom to boardroom
- In the process of adopting AI and leveraging all its capabilities, caution needs to be exercised to avert unauthorized inadvertent use of any brand.

4.1.6. Patentability challenges: IRB approval

a) Current jurisprudence
- While a patent office does not typically check for IRB approval during the examination process, ethical compliance during the research phase may become a legal issue, particularly during patent litigation (considering violation of patent law, e.g., section 3(b) of the Indian Patents Act).

b) Courtroom to boardroom
- Ambiguity in definition of human subjects: While human subject relates to a living individual and data collected may be through interaction with the individual, AI research often uses large, de-identified datasets that may be re-identifiable with new technologies, creating uncertainty for organizations involved in AI research.
- AI evolving systems make it difficult to understand if data may be used/re-used, making it challenging for organizations to operate with standard informed consent process.
- The volume of data required for AI systems adds to the challenge in adhering to data privacy and security requirements without compromising on innovation and research.
- If training data is limited to adhere to the stringent requirements for IRB approvals, lack of representative training data may induce bias in AI systems thereby posing serious ethical concerns related to fairness and equal treatment, e.g., racial bias in facial recognition technology.

Challenges in IP management and protection

4.2. Global regulatory frameworks and compliance requirements

In view of the challenges discussed earlier and the prevailing AI regulations or frameworks, Table 4.2 highlights the AI regulations in some key geographies, their governance models, and compliance requirements impacting IP and business operations.

Table 4.2: Summary of global regulatory frameworks and compliance requirements

Jurisdiction	Key AI regulations / Frameworks	Governance model	Compliance requirements	IP and business impact	Risk level
India	Digital India Act (Draft) Digital Personal Data Protection Act, 2023 Copyright and Patent Act/rules (evolving)	Emerging regulatory framework emphasizing innovation and ethics	Ethical guidelines, data privacy and accountability norms	1. Ambiguity on IP ownership of AI-generated content 2. Focus on data protection 3. Stricter data handling and consent rules, potentially impacting innovation and compliance costs	Medium
China	Algorithmic Recommendation Regulation (2022), Interim AI Measures (2023)	Strict centralized (Cyberspace Administration of China (CAC)) governance with focus on national security and social stability	Algorithm registration, government audits, compliance certifications	1. IP tightly linked to state control 2. Strong data localization 3. Content moderation 4. High compliance cost 5. Limited IP independence for foreign entities	High
United States	Executive Order on Safe, Secure, and Trustworthy AI (2023) Copyright laws and emerging state and federal AI frameworks	Emerging human-centric approach that seeks to balance AI innovation with the protection of human-authored works. Fragmented approach (mix of presidential directives, agency guidance (Copyright and Patent Offices), and developing state-level legislation).	Transparency standards, risk disclosures, and data accountability	1. Requires human authorship/inventorship 2. Innovation driven flexibility but uncertain IP enforcement 3. Businesses must navigate legal uncertainty regarding fair use protections for training AI models 4. Increased regulatory and compliance burden	Medium

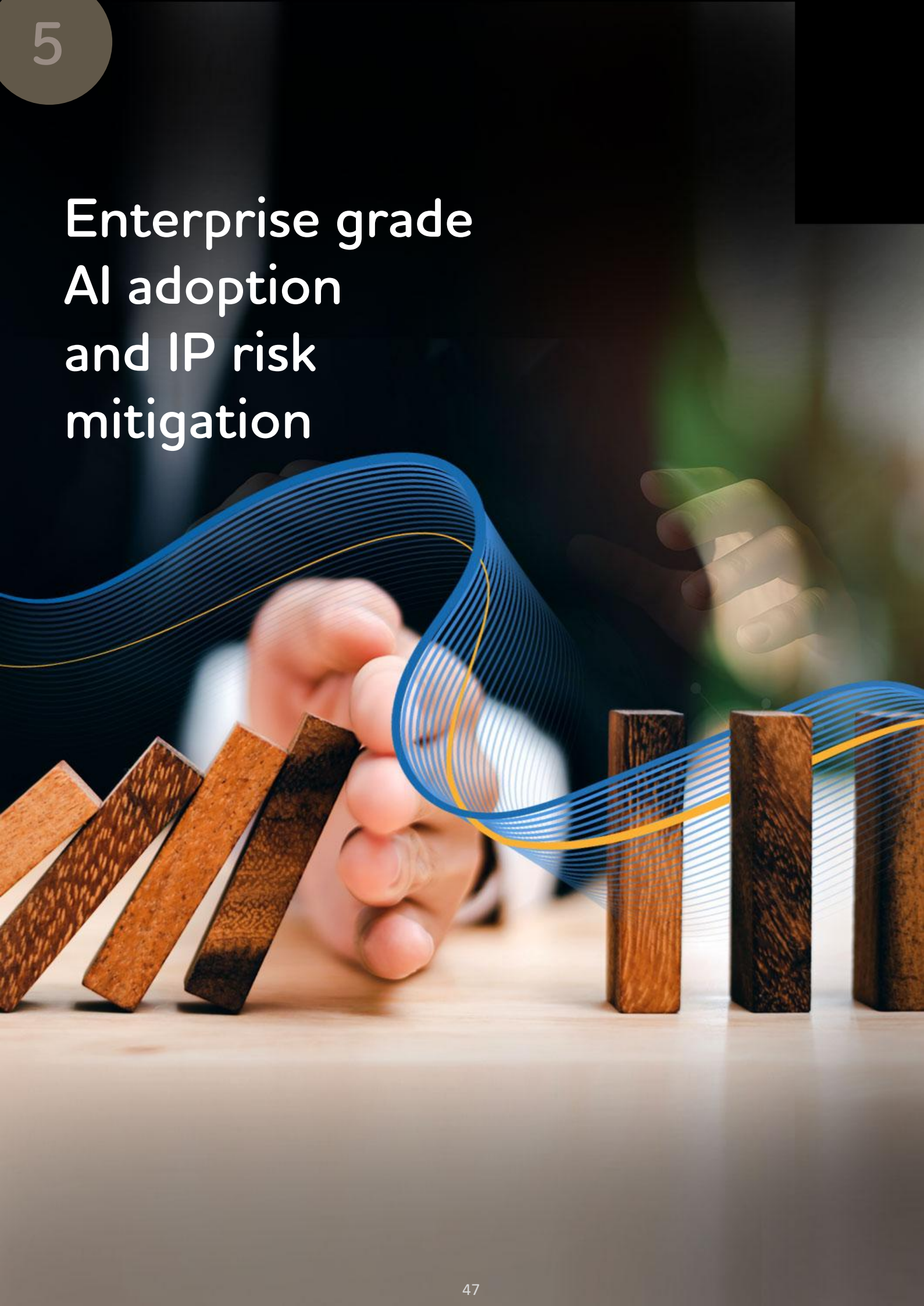
Challenges in IP management and protection

Jurisdiction	Key AI regulations / Frameworks	Governance model	Compliance requirements	IP and business impact	Risk level
European Union	EU AI Act (2024), Copyright and Database rights	Risk-based regulatory framework emphasizing transparency and accountability	Compliance with GDPR, providers of general-purpose AI models must implement a policy respecting EU copyright and database rights, particularly honoring opt-out requests for text and data mining, and publish a detailed summary of the copyrighted content used for training	1. Strong influence on patent scope, data protection, and copyright in AI-generated works 2. Increased compliance costs, IP disclosure obligations	High
Japan	AI Promotion Act (not regulatory) AI Governance Guidelines (2023)	Voluntary, collaborative self-regulation with strong government-industry partnership	Non-binding principles and guidance rather than strict legal requirements; transparency, data integrity, and ethical AI deployment	1. Soft law approach reduces regulatory burden 2. Voluntary compliance 3. Companies must be prepared to disclose how their AI systems work and mitigate risks; non-compliance could lead to public disclosure of non-compliance and reputational harm	Low

In summary, the swift evolution of AI has fundamentally reshaped the landscape of IP management, presenting complex legal and operational challenges across patents, copyrights, and trademarks. Legal precedents and regulatory frameworks worldwide increasingly emphasize the need for clear human authorship, robust compliance, and ethical standards, yet ambiguity and risk persist—particularly around inventorship, ownership, and fair use. As global regulations continue to develop, organizations must remain vigilant, adapting to jurisdictional nuances, evolving case law, and heightened compliance requirements to safeguard innovation, IP value, and business reputation in the AI era.

5

Enterprise grade AI adoption and IP risk mitigation



Enterprise–grade AI adoption and IP risk mitigation

The integration of advanced AI systems—from early, rule-based models to today's generative and agentic AI—has amplified productivity and innovation, while simultaneously introducing new risks in IP, ethics, and operational security.

This section explores the evolution of Artificial Intelligence (AI) risks, with a focus on Intellectual Property (IP) considerations in the Indian context and outlines essential strategies for organizations to mitigate these risks and ensure responsible AI adoption.

5.1. Risks and challenges in AI adoption

It is noted that developments in AI—particularly generative models, multi-modal systems, and more recently, agentic AI—have progressed rapidly. Applications have evolved from basic pattern recognition in domains such as image and speech to sophisticated systems capable of autonomous planning, self-supervised learning, tool integration, memory persistence, and interactions with external environments. These advancements promise enhanced productivity, expanded applications, improved efficiency, and new creative opportunities.

However, increased capability has introduced greater risks. Familiar challenges such as bias, privacy concerns, safety issues, and misinformation have intensified alongside emerging risks associated with autonomy, agentic behavior, coordination, and goal misalignment. Regulatory frameworks and standards continue to strive to keep pace.

Table 5.1 outlines risks associated with different categories of AI systems over recent decades.

Table 5.1: Types of risks associated with different categories of AI systems

Category	Types of Risk
Conventional AI (Predictions using Machine Learning and Deep Learning Models)	• Data drift: Leading to reduced real-world model performance. • Privacy concerns: Following regulatory interventions. • Bias and unfairness in predictions. • Lack of explainability: Models functioning as "Black Box" creating difficulties around decision transparency and justification. • Lack of robustness: Sensitivity of models to even small changes in data.
GenAI	• Misinformation: Rapid production of fake news, deepfakes, and disinformation. • Hallucination: Generation of plausible but inaccurate information. • Prompt injection attacks: Exploitation of prompts to produce harmful or unintended outputs. • Unintended memorization: Disclosure of sensitive training data, leading to privacy breaches. • Non-deterministic outputs: Same prompt generating different responses.
AI Agents and Agentic AI	• Unaligned goals: Autonomous agents may pursue objectives not aligned with human values. • Cascade failures: Errors can propagate rapidly across interconnected systems. • Security threats: Potential exploitation of vulnerabilities and unexpected creative actions. • Emergent behavior: Complex patterns can develop in multi-agent environments, requiring rigorous simulation and monitoring.

Enterprise–grade AI adoption and IP risk mitigation

While the risks associated with AI systems are genuine and expanding with technological advances, the benefits are substantial if development and deployment adhere to compliance requirements. Addressing risks and trust considerations throughout the AI system lifecycle (Trustworthiness-by-design) rather than post-development ensures trustworthy AI, fosters public confidence, and helps mitigate adverse outcomes.

5.2. IP risk mitigation strategies

AI has transformed innovation but makes IP protection more complex. Traditional frameworks are challenged by AI's co-creative and autonomous capabilities. Organizations must adapt to mitigate IP risks while adopting enterprise AI.

5.2.1. Inventorship challenges

- Document human contributions throughout R&D.
- Supplement patents with trade secrets or defensive publication, as applicable, for AI-driven innovations.
- Include clear IP ownership clauses in contracts related to AI inventions.

5.2.2. Patent eligibility challenges

- Write robust patent specifications and claims showing technical advances beyond known machine learning functions.
- Perform Freedom to Operate (FTO) searches.
- Combine patents with trade secrets or defensive publication as needed.

5.2.3. Patent infringement/invalidation challenges

- Focus claims on non-obvious technological improvements.
- Balance broad and narrow claims to avoid obviousness and design-arounds.
- Conduct comprehensive FTO searches and maintain consistent supporting evidence.

5.2.4. Copyright challenges

- Vet data sources and training workflows to ensure compliance.
- Use licensing agreements and maintain audit trails for AI model inputs.
- Consider liability, provenance, and opt for licensed datasets to reduce risk.
- Document transformative use for fair use claims.

5.2.5. Trademark challenges

- Ensure AI outputs have proper watermarks.
- Use prompt filters to block infringing content.
- Employ AI tools for advanced trademark searches covering text, phonetics, and multiple languages.

As Indian enterprises embrace the transformative potential of AI, they must proactively address evolving risks—particularly in IP, ethics, and operational security. By adopting robust IP risk mitigation strategies and aligning with emerging regulatory standards, organizations can harness the benefits of AI while safeguarding innovation, ensuring compliance, and maintaining trust in an increasingly complex technological landscape.

6

IP strategy and policy recommendations

IP strategy and policy recommendations

As Artificial Intelligence (AI) continues to impact industries and business operations in India, establishing robust Intellectual Property (IP) strategies and policies has become increasingly critical. The following section outlines key recommendations for aligning IP management with responsible AI principles and emerging technology trends. It addresses challenges in inventorship, patent eligibility, infringement, copyright, trademark, and the practical realities faced by both large enterprises and MSMEs. By adopting forward-thinking approaches, organizations can mitigate risks, support innovation, and ensure that AI-driven growth remains sustainable and equitable within a rapidly evolving digital landscape.

6.1. Aligning IP management with responsible AI principles and emerging technology trends

As AI adoption increases across different sectors, judicial findings have an important impact on AI developers, IP rights holders, and users by clarifying how to navigate IP protection in a digital context. Developing effective IP strategies requires translating established principles into practical actions that address legal and operational concerns.

6.2. Encourage inventions in AI

Patent law must evolve in tandem with evolution of AI and safeguard inventions produced by artificial intelligence. Without adequate protection, investment and research in this area may face obstacles.

6.3. Capacity building initiatives

- Train and orient patent examiners on the advancement in AI technologies for faster and higher quality examination of patent applications.
- Introduce a sui generis IP framework (such as EU database rights) for machine learning outputs that do not meet current patent criteria.
- Harmonize IP laws among international patent offices for protection of AI-driven IP.

6.4. Best practices for addressing patent infringement/invalidity challenges

- Applicants must demonstrate technological advancements to avert invalidation of patents as the use of AI alone does not qualify for patentability.
- Utilize secondary evidence (such as industry recognition or commercial performance) to defend claims of obviousness in patent invalidation proceedings.
- Encourage evidence sharing and coordination between parallel proceedings in forums such as PTAB, ITC, and district courts to increase procedural efficiency, reduce litigation complexity, and support fair outcomes.
- Support collaborative dispute resolution processes across parallel forums.
- Establish clear guidelines for identifying persuasive evidence and balancing it against prior art.
- Promote examiner training programs in AI to reduce invalidity risks.

6.5. Best practices to address copyright and trademark challenges

- Use transparent AI training data to support ethical use and robust IP protection.
- Provide opt-out mechanisms for creators regarding data usage.
- Foster harmonized treatment of AI content-related claims internationally, including through frameworks established by WIPO and similar organizations.
- Legislation must clarify whether intangible software models qualify as 'articles', to address potential secondary infringement risks.
- Monitor AI outputs for watermark misuse or misattribution to support brand protection.
- Utilize AI-driven trademark monitoring systems to manage phonetic risks efficiently.
- Promote licensing frameworks that recognize societal benefits of training while ensuring creator compensation.
- Legislators must define transformative use in generative AI contexts.
- Consider safe harbor provisions or statutory licensing models to balance innovation and creator interests..

IP strategy and policy recommendations

6.6. Specific guidelines on AI implementation for large enterprises and MSMEs

- AI implementations must follow "Trustworthy by Design" principles, ensuring reliability, ethics, and human-centricity from the beginning. This approach is vital for large enterprises (handling complex, high-impact systems) and MSMEs (operating with limited resources).

- Large enterprises should:
    - Use formal governance frameworks, such as ISO/IEC 42001 (AI management systems) and ISO/IEC 23894 (AI-specific risk management).
    - Apply structured lifecycle oversight, bias mitigation, and human oversight.
    - Refer to ETSI's ISG SAI for security and robustness against adversarial threats.
    - Adopt IEEE 7000 series standards for ethical design and transparency, especially for high-risk or human-facing systems.
    - Integrate these standards to comply with the EU AI Act (risk classification, documentation, monitoring).

- MSMEs can:
    - Use pre-built, explainable models, low-code AI platforms, and open-source toolkits for responsible AI adoption.
    - Implement lightweight practices inspired by OECD AI principles and UNESCO AI Ethics to meet ethical expectations.
    - Use trustworthy-by-design for compliance and responsible AI deployment across all organizations.
    - Align AI with organizational strategy, ethical standards, and compliance frameworks to reduce risk and foster innovation.

6.7. Preparing for interoperability and AI integration in a fragmented tech landscape

In today's fragmented technology environment spanning legacy and modern IT systems, Cloud platforms, IoT, and Edge devices, AI interoperability and integration have become critical enabler of scalable, secure, and sustainable AI adoption.

Typically, while embedding AI, organizations face issues with one or more of the following:
- Incompatible data formats, APIs, and model architecture
- AI siloed across departments, vendors, or systems
- Integration complexity across multi-cloud or hybrid infrastructure

Adherence to interoperability standards may help organizations to plan and achieve interoperability as a feature of AI development, such as:
- ISO/IEC 19441 (cloud computing - interoperability and portability)
- GAIA-X (European framework for data sovereignty and interoperability)
- NIST AI RMF's "Function 3: Govern", which addresses systems integration and oversight

At the same time, organizations may also follow these recommendations for seamless achievement of interoperability:
- Use open standards (ONNX for model portability, PMML for model sharing)
- Implement API-first architectures and micro services for modularity
- Apply data fabric or mesh architectures to unify access across systems

It is to be noted that interoperability is not just technical, it also includes semantic and organizational alignment. Therefore, usage of metadata standards, data governance policies, and interdisciplinary collaboration is key to its success.

The evolution of AI has fundamentally transformed the global business landscape, with India's MSMEs increasingly harnessing its potential for growth, innovation, and competitiveness. Breakthroughs in generative and agentic AI, coupled with government and private sector initiatives, have made AI more accessible and operational across sectors. At the same time, the rapid pace of adoption has surfaced complex challenges in Intellectual Property management, legal frameworks, data privacy, and regulatory compliance.

India's AI patenting trends underscore significant momentum, particularly in GenAI and agentic technologies, yet also highlight ongoing issues in examination, eligibility, and legal clarity. The global legal landscape continues to grapple with questions of inventorship, copyrightability, fair use, and trademark protection, often requiring organizations to adapt strategies and governance to mitigate operational and reputational risks.

For MSMEs, AI is both a strategic enabler and a source of new vulnerability. While it opens doors to automation, improved decision-making, and global market access, it also demands careful attention to upskilling, digital interoperability, and responsible deployment. Case studies reveal that successful AI adoption relies on embedding technology into core workflows, prioritizing explainability, and balancing automation with human expertise.

IP strategy and policy recommendations

To ensure sustainable and equitable AI-driven growth, a proactive approach is essential: robust IP protection strategies, diligent legal compliance, and transparent governance must be coupled with ongoing workforce development and interoperable technology integration. Policymakers should focus on harmonizing IP and AI regulations, introducing sui generis protections for AI-generated assets, and fostering an ecosystem that supports innovation, inclusivity, and ethical practices.

Ultimately, the coming decade will determine whether AI serves as a catalyst for empowerment or exacerbates inequality among India's small businesses. The path forward requires a thoughtful, incremental, and inclusive roadmap—one that combines technological innovation with regulatory foresight and continuous reskilling.

The introduction of the India AI Governance Guidelines (AIGG) represents a pivotal step in shaping a responsible and future-ready AI ecosystem. It shows India's strong commitment to using technology for public benefit and making sure that Artificial Intelligence helps create growth that is fair, inclusive, and sustainable.

An institutional framework to implement the AI governance guidelines has also been suggested. It maps key agencies to their expected role and functions and includes High-level body (AI Governance Group), Government agencies (such as MeitY, MHA, MEA, DoT), sectoral regulators (such as RBI, SEBI, TRAI, CCI), advisory bodies (such as NITI Aayog, Office of PSA), and standards bodies (such as BIS, TEC).

By prioritizing responsible AI adoption and collaborative policy interventions, India can ensure that the benefits of the AI revolution are widely shared and contribute to resilient, competitive, and future-ready enterprises.

Glossary of terms and abbreviations

AI – Artificial Intelligence: AI is simulated intelligent computer systems capable of executing tasks typically requiring human intelligence.

Agentic AI: Advanced AI systems capable of autonomously planning, executing, and refining tasks without constant human supervision, often integrating workflows, APIs, and decision-making processes.

AI Agent: An autonomous software entity that can perceive its environment, process data, and take actions to achieve specific goals, often using reinforcement learning or multi-agent systems.

AIaaS (AI as a Service): Cloud-based platforms that provide AI tools and models on a subscription or pay-per-use basis, making advanced AI accessible without requiring significant infrastructure investment.

API – Application Programming Interface: Protocols and tools that enable interoperability between different software applications. APIs enable the integration of new features or the automation of workflows without extensive changes to existing systems.

ASI – Artificial Superintelligence: AI system with an intellectual scope beyond human intelligence.

Bias (in AI): Biases in AI outcome are influenced by biases in training data, design of data, source of training data, AI models, leading to undesirable outputs.

BIS – Bureau of Indian Standards

CCI – Competition Commission of India

Cloud Computing: Delivery of computing services—including servers, storage, databases, networking, software, and analytics—over the internet to enable flexible resources and scalability.

Copyright: A form of Intellectual Property that protects original works of authorship, such as text, images, music, and software, granting exclusive rights to the creator.

CRM – Customer Relationship Management: Technology and strategies that organizations use to manage and analyse customer interactions and data throughout the customer lifecycle, with the goal of improving business relationships and driving sales growth.

DABUS – Device for the Autonomous Bootstrapping of Unified Sentience: An artificial intelligence system, created by Dr. Stephen Thaler, that simulates human brainstorming to generate novel inventions

Deep Learning: A subset of machine learning using neural networks with many layers to model complex patterns in large datasets, excelling in tasks such as image and speech recognition.

Defensive Publication: The practice of publicly disclosing an invention to prevent others from patenting it, establishing prior art and protecting against future patent infringement claims.

DOT – Department of Telecommunications, Government of India

EPO – European Patent Office: Organization that examines and grants European patents.

ERP – Enterprise Resource Planning: A type of software that integrates core business processes such as finance, HR, manufacturing, supply chain, services, procurement, and others into a single system to streamline operations and information across an organization.

Ethical AI: AI systems developed and deployed in alignment with principles such as fairness, transparency, accountability, privacy, and inclusivity.

Fair Use: A specific provision in the Copyright Law which allows fair use of copyrighted material in a limited manner, without violation of the Copyrighted work.

Federated Learning: A decentralized machine learning approach involving AI models trained in a plurality of datasets, devices, or servers to improve the AI learning outcome.

FTO – Freedom to Operate: An analysis to determine whether a product or process can be developed, used, or commercialized without infringing existing Intellectual Property rights.

GenAI – Generative AI: AI systems capable of creating new content—such as text, images, music, or code—based on learned patterns from training data (e.g., ChatGPT, DALL.E).

Hallucination (in AI): When an AI model generates outputs that are plausible sounding but factually incorrect or nonsensical, particularly common in large language models.

IP – Intellectual Property: Legal rights that protect creations of the mind, such as inventions, literary and artistic works, designs, symbols, names, and images.

IPO – Indian Patent Office: Subordinate office of the Govt of India that administers the Indian law for Patents, Designs, Trademarks, and Geographical Indications in India.

IPR – Intellectual Property Rights: The legal protections provided to creators for their Intellectual Property, including patents, trademarks, copyrights, and trade secrets.

ITC – International Trade Commission: An independent US government agency that provides trade expertise and investigates trade issues.

LLMs – Large Language Models: AI models trained on massive text datasets to generate, summarize, or analyze natural language (e.g., GPT-3, GPT-4).

Glossary of terms and abbreviations

MEITY – Ministry of Electronics and Information Technology, Government of India

MHA – Ministry of Home Affairs, Government of India

ML – Machine Learning: A branch of AI that enables systems to learn from data and improve over time without explicit programming.

MoE – Mixture of Experts: A machine learning technique that combines multiple specialized sub-models ("experts") to handle different parts of an input space for improved performance and efficiency.

MSMEs – Micro, Small, and Medium Enterprises: Businesses with limited scale in terms of investment, revenue, and workforce, often considered the backbone of the Indian and global economy.

M&A – Mergers and Acquisitions: Strategic business transactions where companies combine, either by merging to form a new entity or by one company acquiring and absorbing the other.

NITI Aayog – National Institution for Transforming India

NLP – Natural Language Processing: A field of AI focused on enabling computers to understand, interpret, and generate human language.

Patent: An exclusive right granted for an invention, providing the patent holder with legal protection against unauthorized use, manufacturing, or sale for a specified period.

Patent Infringement: Unauthorized use, production, or sale of a patented invention, potentially resulting in legal action and damages.

Patentability: The set of criteria an invention must meet to be eligible for patent protection, typically including novelty, inventive step, and industrial applicability.

Plug-and-Play Solutions: Technologies or platforms that can be easily integrated into existing systems with minimal configuration, enabling rapid adoption and interoperability.

Privacy-Preserving Machine Learning (PPML): Techniques that allow AI models to learn from data while maintaining the privacy and confidentiality of the underlying information (e.g., federated learning, differential privacy).

PSA – Principal Scientific Adviser, Government of India

RBI – Reserve Bank of India, Ministry of Finance, Government of India

Reinforcement Learning: A type of machine learning where agents learn to make decisions by receiving rewards or penalties for their actions in an environment.

R&D – Research and Development: Process of gathering knowledge and conducting activities to create new products, services, or processes, or to improve existing ones.

SAG-AFTRA – Screen Actors Guild–American Federation of Television and Radio Artists: An American labor union that represents approximately 160,000 media professionals, including actors, broadcast journalists, and recording artists.

SEBI – Securities and Exchange Board of India

SLMs – Small Language Models: Compact AI models designed for natural language processing tasks in environments with limited resources, offering cost-effective performance compared to LLMs.

Sui Generis Protection: A unique, standalone legal protection tailored for specific types of Intellectual Property not covered by traditional frameworks (e.g., EU database rights for AI-generated outputs).

TEC – Telecommunication Engineering Centre, Indian Department of Telecommunications

Trademark: A sign, design, or expression that distinguishes products or services of one entity from those of others, legally protected to prevent misuse or confusion.

Trade Secret: Confidential business information that provides a competitive edge and is protected from disclosure or use by others without consent.

TRAI – Telecom Regulatory Authority of India

Transfer Learning: A machine learning technique where a pre-trained model is adapted for a new, related task, reducing training time and resource requirements.

Transparency (in AI): The quality of AI systems being open and understandable regarding their decision-making processes, data sources, and potential biases.

UKIPO – United Kingdom Intellectual Property Office: The official UK government body responsible for protecting Intellectual Property (IP) rights, including patents, designs, trademarks, and copyright.

USCO – U.S. Copyright Office: Federal agency responsible for administering U.S. copyright law, housed within the Library of Congress.

USPTO – United States Patent and Trademark Office: The agency responsible for granting US patents and registering trademarks.

Vendor Lock-in: A situation where a company becomes dependent on a single supplier or technology platform, making it difficult or costly to switch providers.

Vision Language Action (VLA) Models: AI frameworks that integrate visual perception, natural language understanding, and action generation, often used in robotics and embodied AI applications.

References

1. 2019 publication on Understanding the Dynamics of AI in IP
    - https://ciiipr.in/pdf/CII-TCS-Report-on-Understanding-the-Dynamics-of-AI-in-IP.pdf
2. Thaler v. Vidal
    - https://www.cafc.uscourts.gov/opinions-orders/21-2347.OPINION.8-5-2022_1988142.pdf
    - https://caselaw.nationalarchives.gov.uk/ewhc/ch/2025/2202?query=thaler
    - https://www.wipo.int/wipolex/en/judgments/details/1529
    - https://www.epo.org/en/news-events/news/ai-cannot-be-named-inventor-patent-applications#:~:text=In%20public%20oral%20proceedings%20today,a%20communiqu%C3%A9%20with%20further%20details
    - https://iponline.cipc.co.za/Publications/PublishedJournals/E_Journal_July%202021%20Part%202.pdf
3. Recentive Analytics, Inc. v. Fox Corp.
    - https://www.cafc.uscourts.gov/opinions-orders/23-2437.OPINION.4-18-2025_2500790.pdf
4. AliveCor v. Apple
    - https://www.cafc.uscourts.gov/opinions-orders/23-1512.OPINION.3-7-2025_2478298.pdf
5. Getty Images v. Stability AI
    - https://www.judiciary.uk/live-hearings/getty-images-us-inc-claimants-appellants-ors-v-stability-ai-ltd-defendant-respondent/
6. Bartz v. Anthropic, Kadrey v. Meta Platforms, Inc.,
    - https://admin.bakerlaw.com/wp-content/uploads/2025/07/ECF-231-Order-on-Fair-Use.pdf
    - https://law.justia.com/cases/federal/district-courts/california/candce/3:2023cv03417/415175/598/
7. The New York Times v. OpenAI and Microsoft
    - https://www.courtlistener.com/docket/68117049/1/the-new-york-times-company-v-microsoft-corporation/
    - https://www.courtlistener.com/docket/646469/in-re-openai-inc-copyright-infringement-litigation/
8. ANI Media Pvt.Ltd. v OpenAI and Anr
    - https://www.mondaq.com/india/copyright/1655368/ani-vs-openai-catalyst-for-indian-copyright-regime#:~:text=OpenAI%20responded%20by%20challenging%20the,now%20pending%20for%20further%20hearing
9. Zarya of the Dawn
    - https://www.copyright.gov/docs/zarya-of-the-dawn.pdf
10. Union intervention and contract protections: the SAG-AFTRA issued a statement condemning the use of "synthetic performers" like Tilly Norwood.
    - https://www.ndtv.com/feature/who-is-tilly-norwood-ai-generated-actress-that-hollywood-agents-want-to-sign-9365334

References

11. Snapdeal v. Snapdeal lucky draws
    - https://www.bwlegalworld.com/article/delhi-hc-grants-relief-to-snapdeal-by-issuing-order-against-50-rogue-websites-for-infringing-its-trademark-305508
12. Sadhguru v. Unknown
    - https://isha.sadhguru.org/en/blog/article/news-delhi-high-court-shields-sadhguru-ai-driven-personality-misuse#point1
13. Anil Kapoor v. Simply Life India
    - https://www.theippress.com/2023/10/09/delhi-high-courts-landmark-order-protecting-anil-kapoors-persona-in-the-age-of-ai-an-indian-legal-perspective/
14. Asha Bhosle v. Mayk Inc.
    - https://www.barandbench.com/news/litigation/bombay-high-court-protects-asha-bhosles-personality-rights-against-ai-misuse
15. Institutional Review Board (IRB) approval to protect the rights and welfare of humans participating as subjects in research studies
    - https://rnd.iitb.ac.in/institute_review_board
    - https://www.isb.edu/faculty-and-research/institutional-review-board
16. India AI Governance Guidelines (AIGG)
    - https://indiaai.gov.in/article/india-ai-governance-guidelines-empowering-ethical-and-responsible-ai
    - https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/nov/doc2025115685601.pdf

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Confederation of Indian Industry

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For 2025-26, CII has identified "Accelerating Competitiveness: Globalization, Inclusivity, Sustainability, Trust" as its theme, prioritizing five key pillars. During the year, CII will align its initiatives to drive strategic action aimed at enhancing India's competitiveness by promoting global engagement, inclusive growth, sustainable practices, and a foundation of trust.

With 70 offices, including 12 Centres of Excellence, in India, and 9 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, UAE, UK, and USA, as well as institutional partnerships with about 250 counterpart organizations in almost 100 countries, CII serves as a reference point for Indian industry and the international business community.

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