International Journal of Criminal, Common and Statutory Law

**E-ISSN:** 2789-9500
**P-ISSN:** 2789-9497
IJCCSL 2025; 5(2): 26-31

www.criminallawjournal.org
Received: 20-05-2025
Accepted: 21-06-2025

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# Global standards as guardrails: Advancing fair and ethical AI in industry

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**DOI:** https://www.doi.org/10.22271/27899497.2025.v5.i2a.144

**Abstract**
International standards play a pivotal role in industrial governance by providing a unified framework that bridges regulatory fragmentation across borders. By establishing a common language and set of expectations, these standards enable smoother cross border operations for multinational industries and reduce inconsistencies that can arise from differing national regulations. Many countries including India are actively engaged in the development of global standards to ensure the national policies align with and are interoperable with international norms. This alignment not only facilitates international trade and cooperation but also supports the safe, ethical and widespread adoption of AI technologies in industrial settings. Major global standard setting institutions such as the International Organisation for Standardisation (ISO), the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU) are at the forefront of these efforts. These organizations collaborate with governments, industry stakeholders and civil society to develop and update standards that promote trust, transparency and accountability in AI-driven industrial systems, thereby fostering innovation while safeguarding public and worker interests. The article examines the foundational principles that guide global standards in the AI industry emphasizing the critical need for consistent international standards to ensure ethical fairness in industrial governance. Harmonized standards are essential for safeguarding worker rights preventing bias and discrimination and ensuring that AI technologies are used ethically and equitably in industrial contexts.

**Keywords:** Industrial governance, ethics and fairness, global standards, consistent standards, workers right

## 1. Introduction
"The adoption of international standards in a coordinated way is instrumental in ensuring a future of responsible use of AI [1].
Global standard setting institutions such as International Organisation for Standardisation (ISO), the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU) play a critical role in industrial governance by creating and maintaining internationally recognized standards that guide the safe, fair and efficient integration of technology into industry. ISO develops comprehensive standards across most sectors, ensuring that they are globally relevant and can be broadly implemented by industries worldwide. The IEC focuses specifically on electrical and electro-technical standardization producing sector-specific standards that are essential for the safe and reliable functioning of industrial systems and infrastructure. ITU as an intergovernmental organization sets standards for telecommunications and digital infrastructure promoting compatibility and interoperability across global networks while fostering collaboration between public and private sector stakeholders. These institutions operate through open, consensus-driven processes that involve a wide range of stakeholders including governments, industry and consumers ensuring that standards reflect both business needs and broader societal interests. By harmonizing technical requirements lowering barriers to trade and supporting regulatory frameworks, these organizations help build trust, encourage innovation and facilitate the global adoption of new technologies in industrial governance.

## 2. AI and Industrial Governance
The global standard setting institutions play a pivotal and complementary role in shaping the responsible adoption and governance of artificial intelligence (AI) in industrial contexts.

### 2.1 International Organization for Standardization (ISO)

The International Organisation for Standardisation (ISO) develops international standards that serve as comprehensive guidelines for organizations focusing on the establishment, implementation, maintenance and continual improvement of AI management systems [2]. Through its close collaboration with the International Electrotechnical Commission (IEC) under the joint technical committee ISO produces foundational standards, risk management strategies and frameworks for both AI and big data. These standards are developed through a transparent, consensus drive process involving experts and stakeholders from around the globe ensuring they are voluntary yet widely applicable and adaptable to various industry needs. The impact of ISO's work is significant- standards provide organizations with the tools to build trustworthy, ethical and robust AI systems thereby fostering innovation while simultaneously ensuring that societal values and regulatory requirements are upheld. By promoting global cooperation and alignment, ISO standards help organizations demonstrate their commitment to responsible AI practices, ultimately supporting sustainable growth and public trust in AI technologies [3].

ISO/IEC 42001:2023 stands as the world's first internationally recognized standard specifically designed for Artificial Intelligence Management Systems (AIMS), marking ISO as the pioineering standard setter in AI and industrial governance. Its significance lies in addressing unique AI challenges such as bias, data quality, explain ability and post deployment monitoring, offering organizations a systematic approach to manage AI related risks while fostering innovation and trust. It sets a universal benchmark for ethical, secure and transparent AI deployment shaping the future of industrial AI governance worldwide [4].

### 2.2 International Electrotechnical Commission (IEC)

The IEC approach to AI governance is both sector-specific and foundational: it creates vertical standards tailored to industries such as energy, manufacturing and process automation while also collaborating with ISO through the Joint Technical Committee to develop horizontal standards that provide a common framework for AI across all sectors [5]. Notably IEC standards like IEC 61508 and IEC 61511 set the benchmark for functional safety in electrical and electronic systems which are increasingly integrated with AI technologies in industrial environments. Through its conformity assessment schemes, the IEC ensures that these standards are properly implemented fostering trust and accountability in AI deployments. Furthermore, the IEC involvement in initiatives like the Open Community for Ethics in Autonomous and Intelligent Systems (OCEANIS) highlights its commitment to addressing the ethical and societal implications of AI promoting transparency and human centric values [6]. It empowers organizations to integrate AI governance into existing corporate frameworks, manage AI related risks and comply with emerging regulations. Ultimately IEC standards and governance frameworks are essential for enabling safe, responsible and innovative AI adoption in the industrial sector, supporting digital transformation while safeguarding public interest and stakeholder trust [7].

### 2.3 International Telecommunication Union (ITU)

The ITU is a central player in advancing AI governance within the industrial sector by developing international standards that ensure the safe, trustworthy and inclusive deployment of artificial intelligence and machine learning technologies. ITU has published over 120 AI-related standards and is developing more than 130 additional standards, addressing critical aspects such as network orchestration, service quality, operational management and environmental efficiency in industrial contexts. Through its technical standards like the ITU Y.3172 framework for integrating machine learning into 5G and future networks and ITU L.1305 for datacenter infrastructure management- ITU enables industries to optimize operations enhance energy efficiency and ensure interoperability across diverse platforms. ITU's "AI for Good initiative" and global summits foster multi-stakeholder collaboration, translating broad ethical and governance principles into actionable and implementable standards for industrial AI [8]. The ITU Focus Groups such as those on "Machine Learning for Future Networks" and "Environmental Efficiency for AI" provide sector specific guidance and benchmarks helping industries manage risks, address bias and ensure transparency and accountability in AI systems [9]. By promoting global dialogue, consensus building and technical harmonization, ITU standards lower barriers to AI adoption, support regulatory compliance and help ensure that AI driven industrial transformation is safe sustainable and beneficial for all stakeholders.

## 3. Fragmented Regulations: The Case for Global Standards

The fragmented regulatory frameworks highlight the urgent need for harmonized global standards to ensure fair, ethical and efficient deployment of AI across borders. Fragmented regulations present substantial challenges that undermine both innovation and effective risk management making a persuasive case for global standards. Divergent regulatory regime can open administration gaps, weaken enforcement and erode public trust. The key risks associated with such fragmentation include the following.

### 3.1 Compliance Complexity and Increased Costs

Business must navigate multiple, sometimes conflicting set of regulations when operating internationally increasing legal and administrative burdens. Duplicative compliance efforts can lead to higher operational cost especially for multinational companies. Smaller firms may face barriers to entry limiting competition and innovation.

### 3.2 Barriers to International Trade and Collaboration

Inconsistent standards create obstacles to cross border data flows and AI system deployment. Companies may need to redesign products or services for each jurisdiction reducing scalability and efficiency. Fragmentation can hinder global research collaborations and the sharing of best practices.

### 3.3 Regulatory Arbitrage and Loopholes

Firms may exploit less stringent jurisdictions to avoid strict regulations, undermining the effectiveness of safeguards. This can lead to a race to the bottom where countries compete by lowering standards increasing risks to safety, privacy and ethics.

### 3.4 Uneven Protection of Rights and Values

Citizens in different countries may receive varying levels of protection for protection for privacy, safety and nondiscrimination. Fragmented frameworks can result in gaps

where certain harms go unaddressed eroding public trust in AI systems.

### 3.5 Innovation Stifling and Market Fragmentation
Lack of harmonization can slow down innovation as businesses hesitate to invest in markets with uncertain or incompatible regulations. Market fragmentation may prevent the emergence of global AI solutions and standards limiting the benefits of AI for all.

### 3.6 Enforcement Challenges
Difficulty in coordinating enforcement across borders can allow noncompliant actors to operate with impunity. Disparate regulatory approaches may lead to inconsistent enforcement outcomes weakening overall governance.

The absence of unified approach to AI oversight can create confusion, slow progress and undermine public confidence in emerging technologies. The recent challenges [10] face by global tech companies in adapting their AI drive products to comply with both the European Union's AI Act and divergent regulations in the United States have led to delayed launches and inconsistent user experiences [11]. This underscores the importance of establishing coherent international guidelines to foster trust, streamline operations and maximize the positive impact of artificial intelligence worldwide.

## 4. Consistent International Standard: Critical Need
Standards provide a foundational framework for developing, deploying and governing AI systems. They are about setting common guidelines and technical specifications that everyone can agree on. It acts as a rulebook for responsible AI usage. They promote transparency, mitigate risks and address concerns about fairness, privacy and accountability. Without them it would be navigating a minefield blindfolded.

### 4.1 Harmonize AI governance across Countries and Industries
Establishing consistent international standards ensures that AI governance frameworks as aligned globally minimizing discrepancies between national regulations, this harmonization helps organizations avoid the confusion and inefficiencies that arise from navigating a patchwork of local rules, making it easier to manage AI projects that span multiple jurisdictions [12].

### 4.2 Enable Organizations to Demonstrate Compliance and Build Public Trust
Global standards provide clear, universally recognized benchmarks for responsible AI use. When organizations adhere to these standards they can more easily demonstrate compliance with evolving legal and ethical expectations. This transparency fosters public trust in industrial AI systems as stakeholder can be assured that AI is being used safely and ethically [13]. By implementing structured governance organizations can:

- Align actions with regulatory obligations
- Establish transparent processes
- Implement regular monitoring and auditing
- Operationalize ethical principles
- Foster a culture of responsible AI

### 4.3 Ensure Fair, Safe and Reliable AI outcomes in Industrial Applications
A unified framework embeds principles like fairness, safety and reliability into AI development and deployment. This reduces the risk of bias, discrimination and unintended harms ensuring that AI driven processes in sectors such as manufacturing, healthcare and logistics operate predictably and equitably. This ensures human oversight and intervention, clear communication with end users about AI enabled decisions and stake holder engagement to address concerns related to safety, diversity and fairness [14].

### 4.4 Support Regulatory Alignment and Global Market Access
Consistent standards facilitate regulatory alignment making it easier for companies to enter new markets without extensive reengineering of their AI systems. This streamlines global operations, reduces compliance costs and accelerates the adoption of innovative AI solutions across borders [15].

### 4.5 Provide a Universal Framework for Ethical Fairness and Inclusive Development
Global standards provide a foundation for ethical AI development promoting fairness, inclusivity and respect for human rights. This universal approach helps ensure that the benefits of AI are distributed equitably and that marginalized groups are not left behind [16]. It considers long term societal and environmental impacts promoting sustainable and beneficial outcomes for all.

### 4.6 Protection of Fundamental Rights and Societal Values
International standards ensure that individual liberties and human dignity are universally respected and upheld. International agreements such as UDHR and related covenants provide a clear and universal framework outlining essential rights including equality, freedom of expression and protection from discrimination. Consistent global standards are critical to prevent abuses, foster social harmony and guarantee that all individuals regardless of nationality or background enjoy the same level of protection and recourse.

### 4.7 Protection of Labour Rights and Labour Welfare
Existing national frameworks are fragmented and often outdated leaving workers vulnerable to new forms of precarity, algorithmic bias and opaque decision making as AI driven management and gig economy platforms proliferate. Without harmonized international standards companies may exploit regulatory gaps, undermining fair treatment, collective bargaining and occupational safety across borders. It is essential to ensure human oversight of AI decisions, guarantee workers rights to challenge and overturn automated outcomes and mandate transparent worker-inclusive governance of algorithmic systems.

## 5. Foundational Principles of Ai Industrial Governance
The need of setting global standards in AI Industrial Governance has evolved alongside the rapid advancement and proliferation of AI technologies. Initial discussions about standardizing AI began as early as 1980s driven by concerns over the risks posed autonomous systems but it was not until the 2000s when AI became more powerful and widespread that the urgency for formal standards grew. By the late 2010s the focus shifted to establishing ethical and social principles such as fairness and transparency with frameworks like the NIST AI Risk Management Framework and the EU's regulatory proposals marking significant progress. The 2020s have seen a move toward technical standardization with organizations like ISO/IEC developing industry specific guidelines and the EU enacting the world's first comprehensive legal framework for AI (See Table 1).

**Table 1:** Foundational principles

| Principle | Description |
|---|---|
| Transparency and Explain ability | AI systems must be understandable and open to inspection |
| Accountability | Clear responsibility for outcomes and governance processes |
| Fairness and Non-Discrimination | Preventing bias and ensuring equitable outcomes |
| Privacy and Data Protection | Securing personal data and adhering to privacy laws |
| Safety and Security | Protecting systems from misuse, error and breaches |
| Human Oversight | Ensuring human review and intervention as needed |
| Ethical Use and Societal Impact | Upholding rights, fostering positive societal outcomes |
| Continuous Monitoring | Ongoing risk management and system improvement |
| Legal Compliance | Following relevant legal and regulatory standards |
| Stakeholder Engagement | Input from global experts, industry, governments, and civil society to ensure broad relevance and acceptance. |

While there is no universal legal regime convergence is growing around recognized frameworks and technical standards. The EU AI Act sets a legislative benchmark; OECD and UNESCO provide ethical foundations and ISO/IEC standards anchor technical implementation all enabling jurisdictions to advance trustworthy, fair and safe AI. The precise approach varies by region reflecting local priorities and regulatory maturity (See Table 2).

**Table 2:** Principle Compliance

| Principle | Implementation Measures | Standard/ Framework | Exemplifying Jurisdictions | Year of Key Implementation | Details |
|---|---|---|---|---|---|
| Fairness | Bias audits, diverse datasets | OECD AI Principles (2019) | OECD member state, EU, Canada | OECD AI Principles (May 2019); EU AI Act adopted in 2024, requirements phased by 2026; Canada Algorithmic Impact Assessment (AIA) introduced 2020 | OECD principles pioneered international standards; EU AI Act mandates risk-based fairness reviews |
| Transparency | Model documentation | ISO/IEC 22989, EU AI Act 2024 | EU, Japan, Singapore, Hong Kong | ISO/IEC 22989 published 2022; EU AI Act provides transparency for high risk systems, specific obligations from 2025 | Extensive logs and documentation mandatory for high risk AI in the EU |
| Accountability | Audit trails, redress mechanisms | EU AI Act 2024, AIDA Canada 2025 | EU, US (sectoral) Canada China | EU AI Act 2024 enforcement begins fully by 2027; china adopts algorithmic accountability rules | EU National market surveillance authorities required by August 2025 |
| Privacy | Data minimization, privacy by design | GDPR (2018), ISO/IEC 27701 (2019) | EU, UK, South Korea, Kenya | South Korea's Data Privacy Act 2020, AI specific provision by 2026 | GDPR sets the global benchmark with strict requirements enforced since 2018 |
| Safety and Security | Risk assessments, monitoring | ISO/IEC 23894, EU AI Act 2024 | EU, China, South Korea, Japan | ISO/IEC 23894 published 2023, South Korea AI framework Act effective 2026 | Stringent technical audits and incident reporting required in EU and South Korea |
| Human Oversight | Human in the loop, agency controls | UNESCO Ethics Recommendation 2021 | UNESCO signatory states (193), EU | UNESCO Ethics adopted in 2021; EU AI Act mandates human oversight for high risk systems from 2025; national authorities must be designated by August 2025 | Over 190 countries aligning educational and ethical controls to UNESCO; legal mandates in the EU |

The table and timeline illustrate the rapid global convergence on Industrial AI governance frameworks marked by both intergovernmental standards and high impact regional laws coming into force between 2018 and 2027.

## 6. Implementation Challenges

The implementation of AI industry governance standards in practice faces a range of substantial challenges while also exhibiting distinctive trends shaped by regulatory, technical, organizational and ethical dimensions.

### 6.1 Regulatory Fragmentation and Global Divergence

A core challenge lays in regulatory fragmentation is the lack of harmonization across jurisdictions. As countries and regions rapidly introduce AI specific regulations such as EU AI Act [17], China's Algorithmic rules [18] and US Sectoral approaches [19], organizations operating globally must navigate and reconcile conflicting standards, definitions and compliance obligations. This fragmentation increases compliance complexity and costs often requiring tailored local governance protocols or legal entities per jurisdiction [20].

### 6.2 Technical Challenges: Opacity, Data Complexity, Security and Testing

AI systems especially those based on deep learning often operate as "black boxes [21]" impeding transparency [22]. This makes auditing and regulatory scrutiny difficult further exacerbated by the exponential complexity and heterogeneity of the data AI uses and generates.

### 6.3 Organizational Barriers: Governance Gaps and Talent Shortage

Integrating governance frameworks into existing corporate decision making and development practices is a steep ascent for many enterprises. Common barriers include unclear data stewardship responsibilities siloed governance between legal compliance and technical teams and limited AI literacy among both executives and practitioners [23]. Organizations often lack centralized oversight leading to gaps in accountability and compliance vulnerability. Additionally, as AI governance has become a strategic priority reported as a top five issue by almost half of surveyed organizations in 2025 [24] the demand for specialized skills in AI ethics, risk

and compliance has outpaced supply creating a governance talent gap.

### 6.4 Ethical and Socio-technical Risks: Bias and Trust

Ensuring AI fairness, mitigating bias and maintaining public trust are not merely technical or legal issues. The integration of ethical principles into everyday workflows remains one of the most emphasized yet elusive objectives. Real world cases have shown the tangible costs of failing to have human in the loop oversight such as a 2023 UK robo-advisor [25] misclassification incident leading to significant financial and reputational losses. Public and regulator skepticism regarding the opacity of AI decision making especially in high stakes domains like finance or healthcare [26] has heightened transparency obligations; yet industry surveys show that only a minority of organizations maintain auditable, versioned model registries.

### 6.5 Rapid Regulatory Cycles and Evolving Expectations

The pace of both technological advance and regulatory change is accelerating making static or inflexible governance models quickly obsolete. In this fast-moving environment organizations are increasingly adopting phased and iterative governance programs piloting rules and controls in low risk contexts before scaling up and continuously refining processes as mandates and risks shift [27]. This "governance – first" prioritization is also spreading even organizations not yet using AI are investing in governance programs in anticipation of future deployment and compliance needs indicating a strategic trend toward proactive rather than reactive risk management [28].

### 6.6 Data Governance, Privacy and Sourcing Integrity

The reliance on vast, heterogeneous and often third-party datasets introduces data governance complexities unique to AI. Issues include inadvertent inclusion of sensitive personal data compliance with licensing and privacy laws and the challenge of maintaining lineage and integrity across distributed systems [29]. Best practices in data governance such as automated metadata labeling, dedicated stewardship, centralized governance committees and continuous monitoring are emerging to address these challenges but adoption is still uneven.

## 7. Conclusion and Suggestions

The adoption of standardized AI industrial governance is critical for achieving inclusive growth in the AI era. Global standards provide a common language and set of expectations that foster trust, promote fair and transparent practices and enable equal access to AI opportunities for businesses and communities worldwide. By harmonizing regulations and reducing barriers to entry, standardization ensures that the benefits of AI can be shared more broadly driving responsible innovation and economic participation across regions and sectors. However, realizing the full promise of inclusive growth also demands vigilant implementation ongoing adaptability to diverse local contexts and sustained international cooperation. Ultimately standardized governance forms the foundation upon which a more equitable and sustainable AI driven future can be built. The following suggestions hold ground in the scenario.

1. Harmonizing regulatory frameworks across industrial sectors and jurisdictions is essential for effective and interoperable AI governance within the global industry landscape.
2. Improving transparency and accountability mechanisms in industrial AI applications is critical to building stakeholder trust and ensuring responsible deployment across industries.
3. Embedding ethical principles and formal human oversight into industrial AI systems safeguards fairness, workplace safety and respect for human autonomy.
4. Fostering inclusive, multi-stakeholder governance in AI industrial contexts ensures engagement from all key participants namely manufacturers, workers, regulators and consumers in the development and oversight of AI norms.
5. Adopting adaptive and iterative governance mechanisms enables industrial AI regulations to evolve in tandem with rapid technological advancements in manufacturing, logistics and related sectors.
6. Strengthening data governance and system security within AI powered industrial environments is vital to manage operational risk and protecting both corporate and public interests.
7. Recognizing the centrality of global standards provides a unified foundation for responsible safe and harmonized industrial AI development and operations worldwide.

Addressing implementation barriers through sustained capacity building and international industrial cooperation is fundamental to achieving robust and effective AI governance across the industrial sector.

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