COMPENDIUM ON STANDARDIZATION FOR ARTIFICIAL INTELLIGENCE

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

उपभोक्ता मामले, खाद्य और सार्वजनिक वितरण मंत्रालय, भारत सरकार

Ministry of Consumer Affairs, Food and Public Distribution, Government of India

Table of Contents

1. Introduction

Artificial Intelligence (AI) has gained increased attention from various industries and governments across nations. The prospect of AI solving some of society's most challenging issues has fascinated many. Big multinationals and MSMEs across industries are investing in implementing AI. The growth projected for AI and data science technology is $15.7 trillion by 2030[1]. AI has disrupted the global techno-political regime quite significantly in the recent past. From industrial automation to self-driving cars, from medical drug discovery to space exploration, there is a little that the AI revolution has left untouched.

Traditionally, AI has been focused on large scale problems that were either too hard and complex to solve with traditional compute methods or were in specialized emerging areas. This is no longer the case now. Machine learning has widened the applicability of AI. Focus on the digital transformation has created a demand for services and more intelligent analytics.

Usage of AI in various sectors has led to initiate efforts for AI standardization. The Bureau of Indian Standards (BIS), as the National Standards Body of India, recognizes the significance of AI standardization in shaping a secure and inclusive digital future. Recognizing the transformative impact of AI across industries, BIS established the LITD (Electronics and IT Department) 30 Committee in 2018 to spearhead standardization efforts in the field of AI and Big Data. The committee also acts as India's National mirror committee (NMC) to the International Organization for Standardization (ISO)/IEC (International Electrotechnical Commission) Joint Technical Committee (JTC) 1/ Sub-Committee (SC) 42 international committee, ensuring alignment with global best practices.

AI standards aim to address interoperability, trustworthiness, data quality, ethical concerns, and societal impacts while fostering innovation and sustainable development.

This compendium brings together insights, frameworks, and guidelines on AI standardization, addressing key areas such as ethics, safety, risk management, security, and compliance. It aims to serve as a foundational resource for policymakers, industry leaders, researchers, and developers navigating the dynamic landscape of AI technologies.

We extend our gratitude to experts, stakeholders, and organizations that have contributed to the development of this compendium. We hope this document will serve as a valuable reference, promoting the adoption of standardized AI practices and enhancing India's leadership in the global AI discourse.

1. https://www.pwc.com/gx/en/issues/artificial-intelligence/publications/artificial-intelligence-study.html#:~:text=%2415.7%20trillion%20game%20changer&text=AI%20could%20contribute%20up%20to,come%20from%20consumption%2Dside%20effects.

2. AI Standardization -National and global efforts

LITD 30 committee of Bureau of Indian Standards is the Bureau of Indian Standards' committee for Standardization in the area of Artificial Intelligence and Big Data. The committee has members from various stakeholders' groups like Government organization, industry, Academia, R&D institutes, Consumer organizations etc. The institutions like IIT Kanpur, IIT Madras, TCS, Infosys, Ministry of Electronics & IT, CDAC, IISc Bangalore, ISGF, ABB India, CII, NASSCOM, NITI Aayog etc. are active participants on this Committee. LITD 30 identifies the areas for AI standardization based on National priorities in line with the NITI Aayog National Strategy for AI and directives issued from Government from time to time and also pursues these at International level. More details on BIS committee on AI (LITD 30) are available at BIS website LITD 30

Artificial Intelligence being a technology which transcends boundaries, the LITD 30 committee works in sync with the International standardization work of ISO/IEC JTC 1/SC 42, committee of International Organization for Standardization (ISO) and International Electro-Technical Commission (IEC). Experts from 73 countries, including India participate in the work of this AI committee. The committee also has liaison with UNESCO, WTO, World economic forum, ITU, European Commission etc. More details about ISO/IEC JTC 1/SC 42 committee on AI are available at JTC 1/SC 42

BIS Committee, LITD 30 on AI is the national Mirror Committee of this important international AI Committee (JTC 1/SC 42). Only the members represented on BIS committee are eligible to participate and contribute towards international standardization efforts in SC 42. BIS's endeavor is to have strong presence and participation of Indian experts in SC 42 so as to ensure that national priorities and requirements are incorporated while bringing out international standards. This ensures seamless adoption and implementation of the international standards within the country.

AIM of AI Standardization:

- Common concepts and terminology
- Enabling meaningful and Intelligent insights from large amount of data sets
- Defining Characteristics of Quality of Data
- To tackle Governance issues
- To ensure Trustworthiness: security, privacy, ethical and societal consideration aspects

3. Artificial Intelligence – Key topics of standardization

- Foundational Standards
- Data – AI, Big Data Analytics
- Trustworthiness of AI Systems including Governance
- Societal Concerns and Ethics
- Use Cases and Applications
- Computational Methods, Algorithms

3.1 Foundational Standards

3.1.1. Key standards published

1. **IS/ISO/IEC 22989:2022 Information Technology - Artificial Intelligence - Artificial Intelligence Concepts and Terminology**

   This standard provides terminology and foundational concepts in AI, including data, neural network, supervised and unsupervised learning, reinforcement learning, machine learning algorithms, computer vision, image recognition.

2. **IS/ISO/IEC 23053:2022 Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)**

   This standard establishes a comprehensive framework for AI systems using machine learning. This framework helps to distinguish between the immediate practical issues related to use of ML in AI systems and popular concerns related to general AI that are often not grounded in technological reality. It also defines some core concepts of AI such as deep learning, convolutional, deep convolutional neural networks, recurrent neural network, feed forward neural networks.

3. **IS/ISO/IEC 42001:2023 Information technology — Artificial intelligence — Management system**

   This document provides a framework for organizations to establish, implement, maintain, and continuously improve an AI management system (AIMS) to ensure AI systems are used responsibly while balancing innovation and compliance with regulatory and ethical considerations.

3.2 Data Standards

3.2.1. Key standards published

4. **IS/ISO/IEC 20547 Series Information technology — Big data reference architecture**

   This series of 4 documents describes a reference architecture for Big Data, focusing on key data characteristics such as volume, velocity, variety, and variability. It emphasizes scalable and distributed data processing, enabling effective handling of diverse datasets.

5. **IS/ISO/IEC 8183:2023 Information technology — Artificial intelligence — Data life**

cycle framework

This standard outlines a data lifecycle framework for AI systems, covering stages like acquisition, processing, deployment, and decommissioning. This standard ensures robust data management practices to support AI applications. This does not define specific services, platforms or tools.

6. **IS/ISO/IEC 24668: 2022 Information technology — Artificial intelligence — Process management framework for big data analytics**

This standard provides a framework for developing processes to effectively leverage big data analytics across the organization irrespective of the industries or sectors. It specifies process management for big data analytics with its various process categories taken into account along with their interconnectivities.

3.2.2. Standards under development

7. **IS/ISO/IEC 5259 Series Artificial intelligence —Data quality for analytics and machine learning (ML)**

These standards define foundational concepts and terminology related to Data quality for analytics and machine learning (ML), describes processes to manage and evaluate data quality throughout the data lifecycle, specifies quantitative and qualitative measures for evaluating data quality attributes like accuracy, completeness etc. These standards also provide methods and techniques for evaluating the quality of datasets used in AI/ML and describes data quality governance framework.

3.3 Trustworthiness and Ethics

3.3.1. Key standards published

8. **IS/ISO/IEC 23894:2023 Information technology — Artificial intelligence — Guidance on risk management**

It provides guidance on how organizations that develop, produce, deploy or use products, systems and services that utilize artificial intelligence (AI) can manage risk specifically related to AI. The guidance also aims to assist organizations to integrate risk management into their AI-related activities and functions. It moreover describes processes for the effective implementation and integration of AI risk management.

9. **IS/ISO/IEC 24029 Series Artificial Intelligence (AI) — Assessment of the robustness**

of neural networks

This series of documents describes methodology for assessment of robustness of neural networks. Methods described are formal methods, statistical and empirical methods.

10. **IS/ISO/IEC 38507:2022 Information technology — Governance of IT — Governance implications of the use of artificial intelligence by organizations**

    This document provides guidance for members of the governing body of an organization to enable and govern the use of Artificial Intelligence (AI), in order to ensure its effective, efficient and acceptable use within the organization.

11. **IS/ISO/IEC 25059:2023 Software Engineering - Systems and Software Quality Requirements and Evaluation (Square) - Quality Model for AI Systems- Quality Model for AI systems**

    This document outlines a quality model for AI systems and is an application-specific extension to the standards on SQuaRE. The characteristics and sub-characteristics detailed in the document provide consistent terminology for specifying, measuring and evaluating AI system quality. The characteristics and sub-characteristics detailed in the model also provide a set of quality characteristics against which stated quality requirements can be compared for completeness.

12. **IS/ISO/IEC TR 5469:2024 Functional Safety and AI Systems**

    This document describes the properties, related risk factors, available methods and processes relating to use of AI inside a safety related function to realize the functionality; use of non-AI safety related functions to ensure safety for an AI controlled equipment; use of AI systems to design and develop safety related functions.

13. **IS/ISO/IEC/TS 25058: 2024 Systems and Software Engineering- Systems and Software Quality Requirements and Evaluation (SQuaRE) -Guidance for Quality Evaluation of Artificial Intelligence (AI) Systems**

    This standard provides guidance for quality evaluation of AI systems using an AI system quality model. The document is applicable to all types of organizations engaged in the development and use of AI.

3.4 Societal Concerns and Ethics

3.4.1. Key standards published

14. **ISO/IEC TR 24368:2022 Artificial Intelligence - Overview of Ethical and Societal Concerns**

    This document provides a high-level overview of AI ethical and societal concerns and also provides information in relation to principles, processes and methods in this area;

3.5 Artificial intelligence - Use Cases and Applications

3.5.1. Key standards published

15. **IS/ISO/IEC 24030:2021 Artificial intelligence - Use Cases**

    This document provides a collection of representative use cases of AI applications in a variety of domains like agriculture, home service robotics, media and entertainment, construction, ICT, mobility, defence, knowledge management, public sector, digital marketing, legal, retail, education, logistics etc. Deployment mode of such use cases covers modes like cloud services, cyber-physical systems, embedded systems, hybrid, on-premise systems. The standard has over 100 use cases.

16. **IS/ISO/IEC 5339:2024 Guidance for AI applications**

    This document provides guidance for identifying the context, opportunities and processes for developing and applying AI applications. The guidance provides a macro-level view of the AI application context, the stakeholders and their roles, relationship to the life cycle of the system, and common AI application characteristics and considerations.

17. **IS /ISO/IEC 5338: 2023 AI System Life cycle process**

    This document defines a set of processes and associated concepts for describing the life cycle of AI systems.

3.6 Computational Methods, Algorithms

3.6.1. Key standards published

18. **IS/ISO/IEC TR 24372:2021 Overview of the state of the art of computational approaches for AI systems**

    This document provides an overview of the state of the art of computational approaches for AI systems, by describing main computational characteristics of AI systems as well as main algorithms and approaches used in AI systems.

19. **IS/ISO/IEC TS 4213:2022 Assessment of classification performance for machine learning models and algorithms**

    This document specifies methodologies for measuring the performance of AI models for classification, regression, clustering and recommendation tasks.

4. International Standardization -Under India’s leadership

Indian experts which are part of the BIS committee on AI have been actively contributing in the activities of ISO/IEC JTC 1/SC 42 in bringing out International Standards on "Artificial Intelligence". Some of the International Standards have been conceptualized with in BIS

committee and Indian experts have taken these further to International committee. Such projects have been developed/are being developed as ISO/IEC documents under the leadership of Indian experts. Some of these are as listed below:

1. **ISO/IEC 24668:2022 Information technology — Artificial intelligence —Process management framework for Big data analytics** (Project Leader- Mr. Gautam Banerjee, Data Science Foundation India)

   This standard provides a comprehensive framework for identifying and assessing key aspects for successful implementation of Big Data Analytics projects within the organization.

2. **ISO/IEC 5339:2024 Information Technology — Artificial Intelligence — Guidelines for AI applications** (Project Leader-Dr. Shrikant Bhat, ABB India)

   This standard provides guidelines for identifying the context, opportunities, and processes for developing and applying AI Applications. The document provides a macro level view of an AI Application and a common framework that includes the make, use, and impact perspectives of AI systems.

3. **ISO/IEC DTS 42119-3 Artificial intelligence — Testing of AI — Part 3: Verification and validation Analysis of AI systems** (Project Leader-Mr. Raghavendra Bhat, Intel India) – *Under development*

   This document describes approaches and provides guidance on processes for the verification and validation analysis of AI systems including formal methods, simulation and evaluation.

4. **ISO/IEC CD TR 42106 Overview of differentiated benchmarking of AI system quality characteristics** (Project Leader-Dr. Nisheeth Srivastava, IIT Kanpur) – *Under development*

   This document provides an overview of conceptual frameworks for graded benchmarking of AI system quality characteristics. The aim is to examine the feasibility of using differentiated benchmarking of quality characteristics based on the complexity and context of use of an AI system.

5. **ISO/IEC AWI 25590 Information technology — Artificial intelligence —Guidance for Generative AI Applications** (Project Leader-Dr. Shrikant Bhat, ABB India)– *Under development*

   This document provides guidance to measure quality of output data obtained using generative AI applications. This document also provides key considerations towards output

data quality which can be considered based on the context and usage of generative AI applications.

6. **ISO/IEC AWI TS 25570 Information technology — Artificial intelligence — Reliability assessment of AI Systems** (**Project Leader-**Dr. C. Anantaram, Retired Principal Scientist, TCS)– *Under development*

   This document provides methods and mechanisms to assess the reliability of an AI system. It describes the metrics of reliability and the procedure for reliability assessment from a statistical perspective.

7. **ISO/IEC AWI TS 25569 Artificial intelligence —Implementation guidance on de-identification of data used in Machine Learning (ML)** (Project Leader-Mr. Srinivas P, VP, Infosys)– *Under development*

   This document provides implementation guidance on de-identifying data used in machine learning. The guidance includes methods that can be used during machine learning model development.

8. **ISO/IEC PWI 25864 Resilience Assessment of AI Systems**

   This document intends to describe the methods to assess the resilience of AI systems. It describes the guidelines, and methodologies for the assessment.