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Little book of AI

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Executive summary

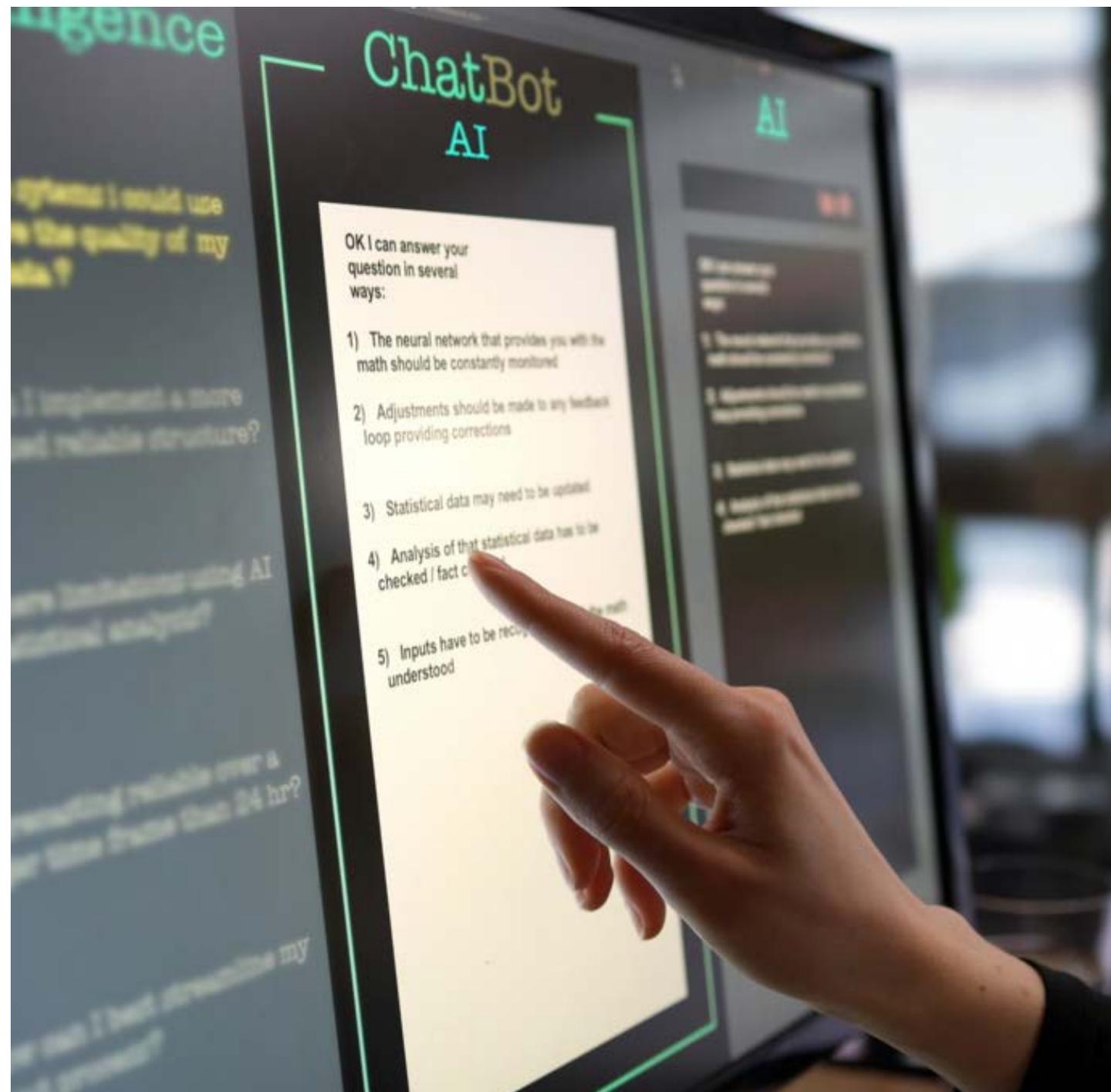
The artificial intelligence (AI) market is growing quickly, and not just in generative AI like ChatGPT and Bard. If risks are managed responsibly, significant benefits can be realized.

This Little Book sets out to explain how AI standards provide a flexible approach to managing all aspects of AI development and responsible use. AI standards are business enablers that can help organizations comply with emerging regulations, improve processes and products and meet customer requirements.

ISO/IEC Joint Technical Committee 1 is a collaboration between the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). It is a collaborative committee that develops and publishes

international standards for information technology and related fields. ISO/IEC standards on the governance of AI, the AI management system and AI risk management are the cornerstone for accessing AI standards.

ISO/IEC 42001, an AI management system standard [1], will be published soon and can be used for conformity assessment and certification, increasing trust in the complex AI supply chain. It can be compared to ISO 9001 for quality management or ISO 27001 for information security management.



Introduction



2.1 What is Artificial Intelligence?

AI is an interdisciplinary field broadly based on computer science, data science, humanities, social sciences and more. Related research and development is concerned with the mechanisms and application of AI systems.

Standards define an AI system broadly as an engineered system that generates outputs such as content, forecasts, recommendations or decisions for a set of human-determined objectives [2]. This focus on inputs and outputs allows us to compare and classify AI systems based on their properties.

Machine learning is one of the most important topics in AI; it is the process of optimizing a model's parameters through computational techniques, such that the model's behaviour reflects the data or experience [2]. In simple terms, the model learns how to behave from data rather than conventional and explicit software code.

AI technologies introduce new risks, as do the emerging capabilities of those technologies. Hence, many are focused on the responsible use of AI.

2.2 Key statistics on the growth of AI

- The current AI market size is estimated at USD 200 billion [3] and is estimated to grow nearly ten times larger by 2030.
- IBM's Global AI Adaption Index reported in 2022 that 35% of companies reported using AI in their business, and an additional 42% were exploring it [IBM, 2022].
- Two thirds of companies expect to use AI to achieve their sustainability goals [4].





2.3 Why do organizations need to know about it?

Organizations need to understand AI because it is a transformative technology. It can significantly enhance operational efficiency, decision-making and strategic development. By leveraging AI, organizations can gain insights from data that were previously impossible or very time-consuming to obtain, enabling more informed and timely decisions. AI enables the development of new products, services and business models, fostering innovation and competitive advantage.

Failing to gain an understanding of AI exposes organizations to risks, including falling behind competitors and being vulnerable to legal, security and ethical issues related to AI systems. Indeed, many people think that companies won't be displaced by AI itself but by other companies that use AI in a better way.

Given the ubiquitous and transformative nature of AI across industries, having knowledge of AI is imperative for organizations to remain competitive, innovative and relevant in the digital age.

AI use across industries





3.1 Exploring the application of AI in various sectors

AI is increasingly used in diverse sectors such as health, defence, transport, finance, employment and energy.

AI can benefit stakeholders by improving the performance of certain functions or enhancing the efficiency of existing ones. For example, in large-scale trials in the UK, it has been shown that AI can achieve better accuracy than a human radiologist [5].

As well as the economic benefit of that, AI can help protect the environment and enable sustainable practices.

87% of climate and AI leaders find AI to be a helpful tool in the fight against climate change [6],

citing examples such as linking satellites and AI for surveillance and monitoring.

3.2 Industry-specific examples of benefits, challenges and other use cases¹

01

Traffic management

AI is used to manage traffic, increasing the accuracy and efficiency of detection of driving infractions and monitoring and analysing the flow of traffic. Data from multiple sources, including the flow of traffic, details of vehicles and pedestrian movement is aggregated and used with various machine learning frameworks.

Example applications include enforcing regulations such as detecting speeding and incorrect parking. They also include traffic light optimization – based on real-time and historical data, traffic lights are tuned in real time to reduce traffic.

The result has been a tenfold increase in the efficiency of infraction detection and increased the speed for vehicles to pass through major junctions by 9% to 25%. Challenges include the hardware required for performing computation upon approximately 100 terabytes of data per day and maintaining consistent data interfaces between different resources and applications. Quality issues can arise depending on weather conditions.

¹ The examples in this section are sourced from ISO/IEC TR 24030:2021, *Information technology — Artificial intelligence (AI) — Use cases*.



02

Smart agriculture

AI is used in research to create low-power systems that include AI for real-time plant segmentation and growth predictions. These systems are intended to be used in greenhouses and remote areas to, for example, detect harmful plants. Challenges include variance in illumination, weather, seasonal and local conditions. Natural variations between localities mean the system cannot replace an experienced agronomist.

Other use cases in agriculture include recommending crop rotation and monitoring for insect attacks using drones.

03

Automated facial recognition

Facial recognition is employed in various situations by a range of organizations spanning multiple sectors. It possesses the ability to detect a face within an image and subsequently establish a distinctive facial pattern. This pattern can then be compared to other images stored in a database to either confirm a strong resemblance (e.g. matching against an identity document) or identify the presence of an individual at a particular place and time (e.g. recognizing a person at a public event) if their image is stored in a database.

Facial recognition technology can be both trusted and not trusted, depending on the context of its use and who controls it. It is an example of how AI needs to be managed responsibly within standardized frameworks.



Understanding AI standards



4.1 Definition and significance of AI standards

Standards are an agreed way of doing things, a tried and tested set of good practices.

There are many AI-related standards under development, and it can be helpful to think of them as a layered model. The core cross-industry standards that help organizations implement an AI governance structure and management system are the foundations. This leads organizations to establish objectives and identify risks relating to their use of AI. As they establish clearer goals, there are other technical standards in development about specific AI themes, topics and technologies. These can complement the foundational layer with best practices and risk treatments, as can sector- or application-specific standards.





4.2 The role of AI standards in ensuring quality, privacy and safety

AI standards can help to improve quality by providing models to define quality requirements [7], supporting the improvement of processes that relate to AI, and be used for testing and evaluation of AI systems [8]. Data privacy issues that relate to AI can be managed by implementing processes related to data, which are extensively covered in AI standards

In the context of product safety standards, the current set of cross-sector AI standards can be used as a base to build new standards or update existing ones. For example, harmonized standards for machinery currently require industrial robots to slow down dramatically in the event of human presence. This may need to be updated when AI innovations can provide better risk mitigations.

In highly regulated areas such as healthcare and medical devices, it is expected that sector-specific AI standards are being developed to cater for particular sectors or use cases in more detail. Some early projects are already published [9]. This is intended to build upon the cross-sector foundational work achieved so far.

4.3 Overview of the current landscape of AI standards

ISO/IEC SC 42 is the joint sub-committee established by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) to provide standardization in the area of artificial intelligence (AI). In 2018, SC 42 was formed as a response to the rapid growth and widespread adoption of AI technologies worldwide. SC 42's goal is to establish a unified and consistent framework for AI standards. The work is ongoing, particularly given the dynamic and ever-evolving nature of AI technologies.

CEN/CENELEC JTC 21 is the joint technical committee established by CEN (European Committee for Standardization) and CENELEC (European Committee for Electrotechnical Standardization). JTC 21 has been tasked by the European Commission to start to adopt or produce AI standards in support of the AI Act. It is expected that once the AI Act itself is finalized, a further request will be made to identify or develop



standards that provide “presumption of conformity”. This is using the same legal and conformity assessment framework applicable under the Machinery Directive and the Medical Devices Regulation. Part of its work is identifying standards from ISO/IEC SC 42 that can be adapted or adopted so that a common foundation can be maintained. This approach can be beneficial for innovation and for small businesses, as it provides clarity and minimizes legal exposure and costs.

In European standards, ISO/IEC work is starting to be adopted, such as ISO/IEC 22989. However, there is also likely to be a number of European Norms developed independently in the coming years.

Both AI committees are looking at AI in general, and they both have an increasing number of liaisons and joint working arrangements with sector-specific committees covering particular technologies or use cases.

Benefits of AI standards for organizations



The 5 benefits of AI standards

01

Enhancing operational efficiency

AI can be used in many ways to make organizations more efficient. The upcoming AI management system standard [1] and its related AI standards can help an organization optimize their investment in AI while deploying it responsibly for the organization and their customers. AI standards can also be used in the AI supply chain, reducing procurement friction.

02

Improving product and service quality

Standardized metrics and testing methods allow for a consistent evaluation of AI systems. This ensures that businesses can accurately compare the efficiency and accuracy of different AI solutions, leading to better-informed adoption and deployment decisions. For example, there is a standard specifying metrics for machine learning classification performance [10].

ISO/IEC 25059 [7] establishes a quality model for AI systems and introduces new concepts such as functional adaptability, user controllability, transparency, robustness, intervenability and social and ethical risk mitigation.

03

Mitigating risks and legal compliance

The technical and regulatory environments for AI are currently fast-moving. This can be managed using existing risk systems, supported by flexible guidance from AI standards. As new regulatory requirements emerge, an established AI management system will provide the foundational system to implement them.

According to the AI risk management standard [11], AI risks are related to:

- Fairness
- Security
- Safety
- Privacy
- Robustness
- Transparency and explainability
- Environmental impact
- Accountability
- Maintainability
- Availability and quality of training testing data AI expertise

These risk sources are caused by:

- The level of automation
- The complexity of the environment
- System life cycle issues
- System hardware issues
- Technology readiness
- Machine learning issues
- Lack of transparency and explainability

04

Facilitating innovation and competitiveness

Standards provide an agreed way of doing things, and this supports and enables the whole AI supply chain by reducing uncertainty, and, in turn, driving innovation.

Standards can also help with the interoperability of AI products and services, economies of scale in areas like professional training, enhanced consumer trust in AI, and even protection of the environment.

05

Supporting upcoming AI regulation

AI regulation is emerging globally. Technical AI standards provide management mechanisms to prepare an organization using AI within this more regulated environment. They also provide supporting technical best practices to help an organization actually implement the systems.

Implementing an AI management system also helps with compliance with existing data privacy laws, as the data used to train AI and the inferences it makes about people can be personal data.



ISO/IEC 42001: Artificial intelligence management systems **at a glance**



6.1 What is this standard and how was it developed?

ISO/IEC 42001 is designed for any organization engaged in the development or utilization of AI systems.

As AI becomes more integrated into various sectors and applications, there is a growing need to ensure its deployment is done responsibly. The standard aims to guide organizations in continuously improving and iterating responsible processes customized for AI systems.



6.2 What does this standard cover?

The AI management system standard serves as a foundational tool in building trust among stakeholders by ensuring accountability in the responsible creation and utilization of AI tools and solutions.

The intention of this standard is that implementation will enhance trust throughout the supply chain of AI products and services. End users and consumers stand to gain considerably, as the standard mandates measures to mitigate risks associated with AI.

Industry stakeholders, including SMEs, have the option to adopt this standard directly and, when sourcing AI components from third-party providers, ensure that their suppliers adhere to this standard.

For policy-making entities like governments and regulators, this standard offers a framework that, when aligned with their principles and ethical guidelines, can aid in ensuring compliance with their regulatory goals.

6.3 What are the business benefits of this standard?

AI is increasingly utilized in diverse sectors such as health, defence, transport, finance, employment and energy. There are many benefits being realized in many different ways. However, as AI becomes more ubiquitous, concerns are arising about balancing its utility with fairness, the impact of its automated decision-making on individuals, its transparency and explainability, human oversight and safety implications.

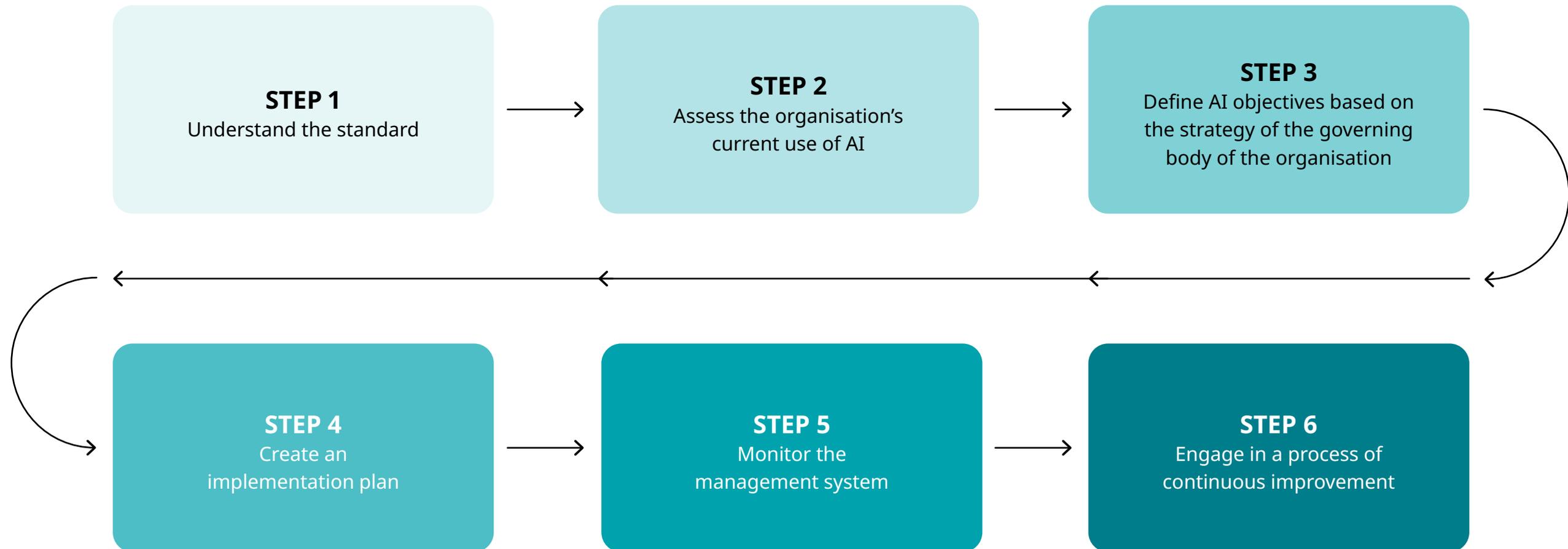
Organizations adhering to this standard in any sector can demonstrate to their customers and supply chain that they are proactively addressing these concerns.

Although not aimed at any specific regulatory requirements, the standard offers a foundation for potential conformity assessment and third-party certification, presenting a flexible, risk-based approach that can be more adaptable than prescriptive sector-specific regulations.

Implementation of the standard also provides confidence for consumers, enhancing their trust in AI-based products and services and, therefore, for the implementing organization.



6.4 How can businesses implement this standard?



Navigating the AI landscape with confidence

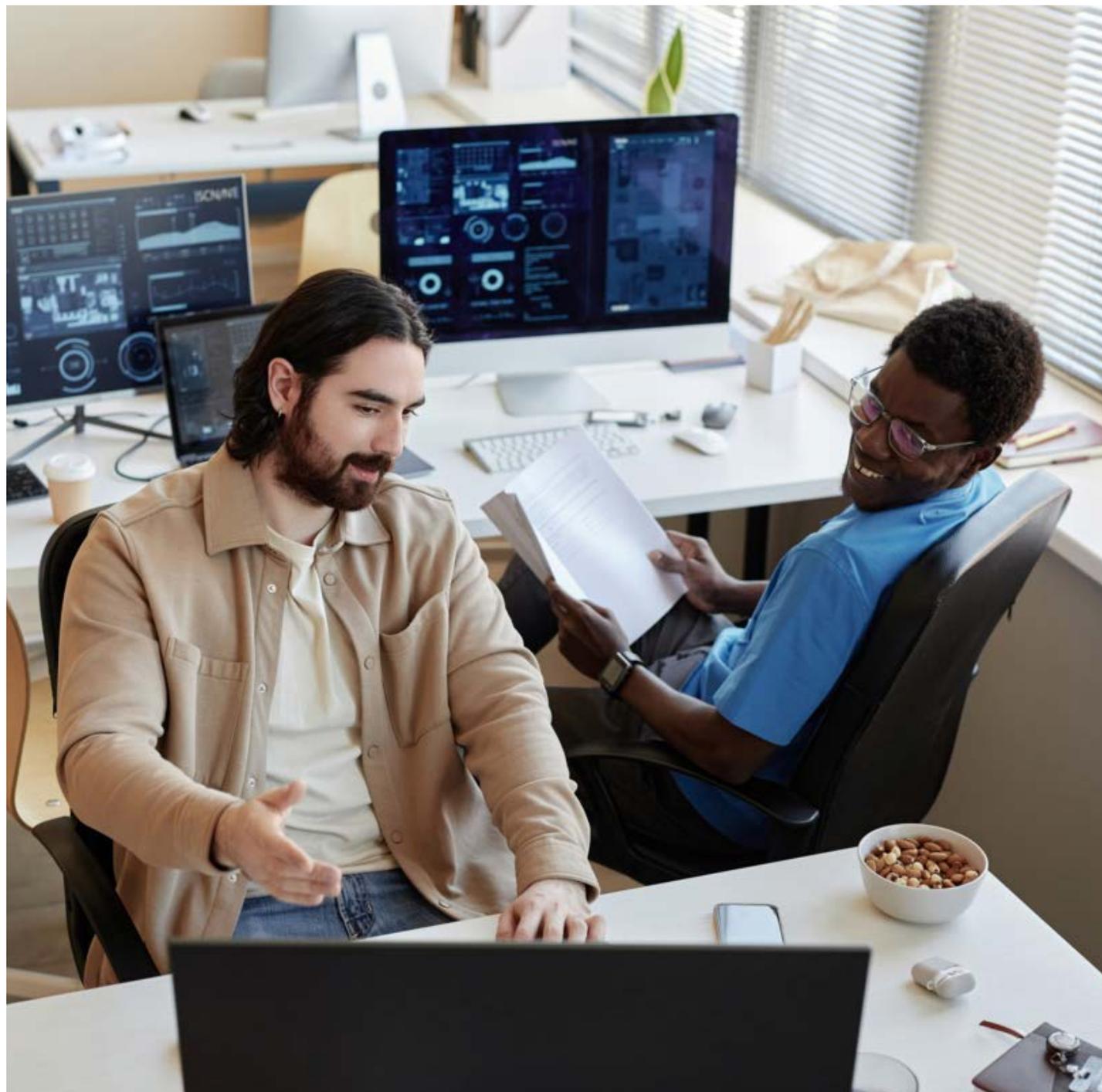


7.1 Addressing common challenges in AI adoption

A common challenge in developing and deploying AI successfully is achieving customer or user or business to business trust.

For example

- 77% of business leaders say AI adoption would increase in their organization if there were fewer risks involved [12].
- 82% of AI professionals say that their organization has suffered problems as a result of problems with bias in AI models or data [13].



AI Glossary for Businesses²

Bias

systematic difference in treatment of certain objects, people or groups in comparison to others

Explainability

property of an AI system to express important factors influencing the AI system results in a way that humans can understand

Controllability

property of an AI system that allows a human or another external agent to intervene in the system's functioning

Transparency

property of a system that appropriate information about the system is made available to relevant stakeholders

Trustworthiness

ability to meet stakeholder expectations in a verifiable way

² Terms and definitions in this section are taken from BS EN ISO/IEC 22989:2023.

7.2 Achieving high quality AI adoption with a standards-led strategy

There are various types of AI standards available to support your strategy:

- Taxonomy (terminology) and foundational standards that describe concepts and terms for AI systems, including an AI quality model.
- Governance and risk management standards customized for AI systems.
- A management system standard that represents best practice for managing the responsible development or deployment of AI systems.
- Technical standards that address topics such as unwanted bias, controllability, explainability and transparency.
- Sector-specific standards developed for specific sectors or applications.

ISO/IEC 42001 should be at the centre of your strategy for standards-based AI development and use. It is the central management system that provides the framework in which the implementation of an AI risk management system sits. It should ideally be used with an AI governance framework guidance [14] that helps an organization set the AI strategy that the management system will implement. An AI impact assessment framework is under development to support the management system.

Specific risks might require a more in-depth application of standards. Technical reports summarizing the state of the art in areas like trustworthiness [15], bias [16], robustness [17], societal and ethical concerns [18] and testing [8] are published to provide informative content on the topics.

Additional technical standards are being published in the near future to provide a quality framework for data, more guidance around treating unwanted bias, a transparency taxonomy, approaches and methods to achieve explainability, and much more.

7.3 Understanding what information is relevant to organizations for developing AI and AI-powered products and services

As well as standards that provide guidance or requirements, there are two standards that are particularly important.

- ISO/IEC 22989 [2] provides concepts and terminology.³
- ISO/IEC 23053 [19] provides a framework for describing a machine learning system and its parts and functions. This can also be a good place to start.

These foundational standards are referenced throughout the SC 42 standards and have been adopted by CEN/CENELEC.

³ Informative aspects of this standard are available on BSI's Standards Development Portal



BSI as a leader in AI standards



8.1 BSI's role in the development of AI standards

Established in 1901, BSI is the UK's National Standards Body. We have been at the forefront of developing internationally-recognized standards on AI for more than five years and work with organizations of every size across all industry sectors, as well as academia and civil society. We understand large, small and medium enterprises and the issues they face, alongside the complex challenges of larger organizations of all types.

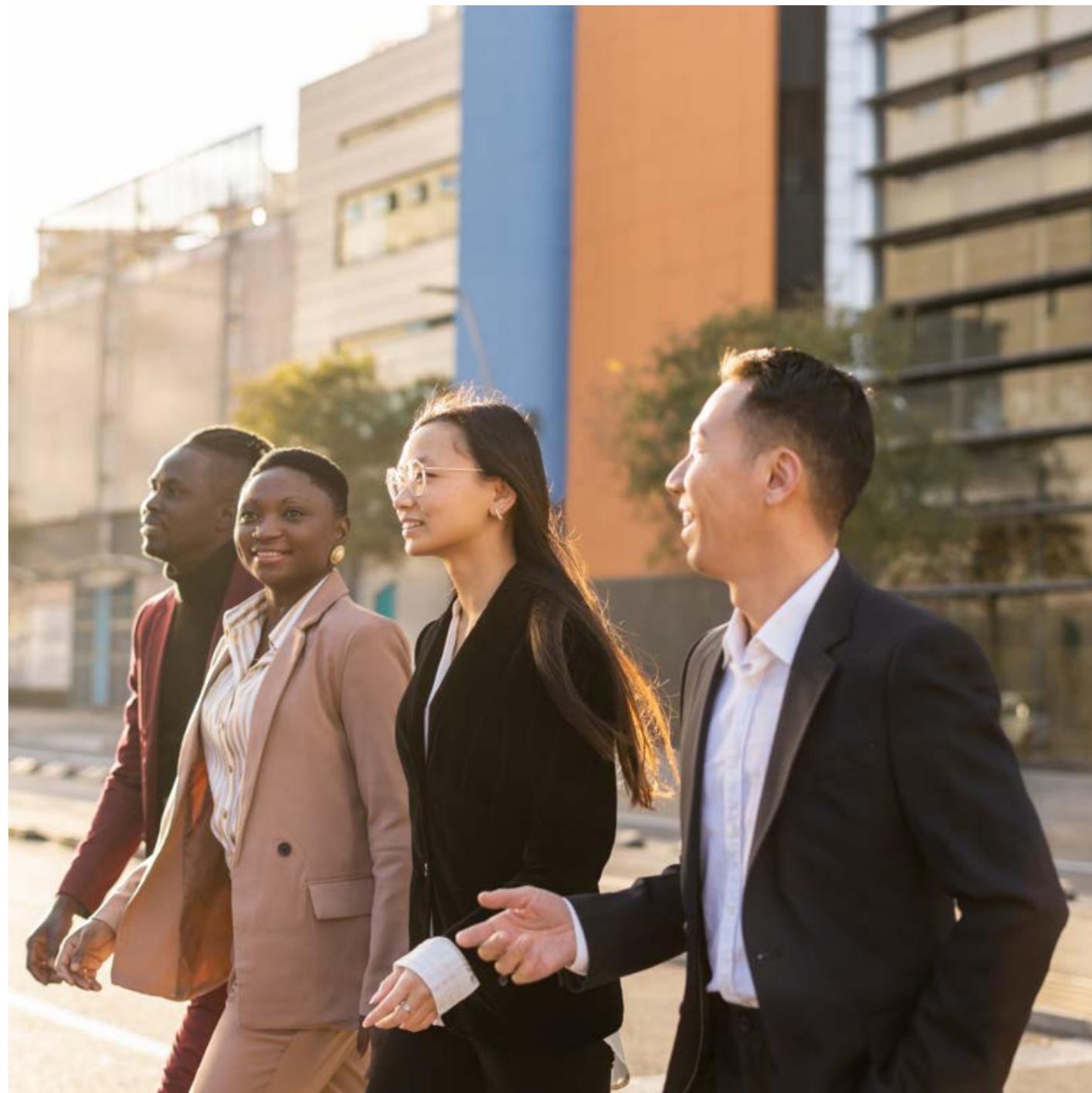
Our role is to help businesses implement best practices and improve the quality and safety of services and systems through voluntary, consensus-driven standards. Aligning with international, European and regional standards bodies makes sure that, through a unified approach, the benefits of AI are realized alongside the benefits of compliance.

The UK is represented in international standards development organizations through BSI's ART/1 committee, which is the national standards committee. ART/1 develops British Standards and contributes inputs to international AI standards through ISO/IEC JTC1/SC42 and CEN/CENELEC JTC 21. ART/1 members also provide direct expert input into international meetings.

8.2 BSI's commitment to providing guidance and support to businesses

Using standards offers a wide range of benefits to your business. They can help improve performance and manage risks you face while enabling you to operate in a more efficient and sustainable way.

Through the clarity of standards and consensus-led industry best practices, you can focus on the responsible deployment of trustworthy AI systems. For BSI, business sustainability is a priority. We strive to align our activities with the United Nations' Sustainable Development Goals (SDGs), which form part of the UN's ambitious strategy to make significant global social and environmental progress. BSI's aim is to help organizations better understand the SDGs, translate them into a business context and introduce impactful measures to align with them. Standards offer a great way to achieve this and demonstrate a responsible approach to AI while increasing organizational innovation.



Conclusion



9.1 Recap of key takeaways

01 The AI market is large, growing, and is likely to deliver increasing opportunities and benefits – if risks are managed responsibly.

02 ISO/IEC standards on the governance of AI, AI management systems and AI risk management are the cornerstone for accessing AI standards, providing a risk-based and flexible approach.

03 The AI management system standard ISO/IEC 42001 is designed for compliance. That also means it can be used for conformity assessment and certification, which can help embed trust in the supply chain.

04 In 2024, more standards should be published by ISO/IEC covering a range of technical topics.

9.2 The importance of embracing AI standards for future success

Standards provide a flexible approach to managing all aspects of AI development and use. They are a business enabler that can help organizations comply with regulations, improve processes and products and meet customer requirements.



Bibliography

[1] ISO/IEC 42001, Information technology – Artificial intelligence – Management system⁴

[2] BS ISO/IEC 22989:2022, Information technology – Artificial intelligence – Artificial intelligence concepts and terminology

[3] Next Move Strategy Consulting, 'AI Market by Component, Deployment, Application, and End-User Industry: Global Opportunity Analysis and Industry Forecast 2022-2030'. Accessed: Oct. 02, 2023. [Online]. Available: <https://www.nextmsc.com/report/artificial-intelligence-market>

[4] 'IBM Global AI Adoption Index 2022', 2022.

[5] A. Bawden, 'Nice recommends use of AI in NHS radiotherapy treatment in England', The Guardian, Aug. 10, 2023. Accessed: Aug. 12, 2023. [Online]. Available: <https://www.theguardian.com/society/2023/aug/11/nice-recommends-use-of-ai-in-nhs-radiotherapy-treatment-in-england>

[6] 'AI Is Essential for Solving the Climate Crisis', BCG Global. Accessed: Sep. 06, 2023. [Online]. Available: <https://www.bcg.com/publications/2022/how-ai-can-help-climate-change>

[7] BS ISO/IEC 25059:2023, Software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – Quality Model for AI systems

[8] PD ISO/IEC TR 29119-11:2020, Software and systems engineering – Software testing – Part 11: Guidelines on the testing of AI-based systems

[9] BS 30440:2023, Validation framework for the use of artificial intelligence (AI) within healthcare – Specification

[10] ISO/IEC TS 4213:2022, Information technology – Artificial intelligence – Assessment of machine learning classification performance

[11] BS ISO/IEC 23894:2023, Information technology – Artificial intelligence – Guidance on risk management

[12] 'AI IQ: Insights on Artificial Intelligence in the Enterprise'. Available: <https://www.workday.com/en-us/why-workday/our-technology/artificial-intelligence/research/ai-iq.html>

[13] IBM, 'Executive Summary: Scaling AI Not Risks Removing Trust as a Barrier to AI Adoption.pdf', 2020. Accessed: Oct. 04, 2023. [Online]. Available: https://filecache.mediaroom.com/mr5mr_ibmnews/189198/Executive%20Summary_Scaling%20AI%20Not%20Risks%20Removing%20Trust%20as%20a%20Barrier%20to%20AI%20Adoption.pdf

[14] BS ISO/IEC 38507:2022, Information technology – Governance of IT – Governance implications of the use of artificial intelligence by organizations

[15] PD ISO/IEC TR 24028:2020, Information technology – Artificial intelligence – Overview of trustworthiness in artificial intelligence

[16] PD ISO/IEC TR 24027:2021, Information technology – Artificial intelligence (AI) – Bias in AI systems and AI aided decision making

[17] ISO/IEC TR 24029-1:2021, Artificial Intelligence (AI) – Assessment of the robustness of neural networks – Part 1: Overview

[18] PD ISO/IEC TR 24368:2022, Information technology – Artificial intelligence – Overview of ethical and societal concerns

[19] BS ISO/IEC 23053:2022, Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)

⁴ This standard is in development.

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