

Standardization in the Field of Artificial Intelligence

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The topic of this paper is standardization in the field of artificial intelligence. The problem of covering this area with standards by leading International and European organizations for standardization is explored. The paper reviewed certain important standards, recommendations, technical reports and technical specifications and presented the space and domain of their application. The possibility of application is explained, as well as the presentation of the landscape of standardization in the field of artificial intelligence. The standards in preparation and the published standards of the most important international and European organizations, ISO, IEC, ITU, IEEE and CEN-CENELEC, are presented. The paper shows what is currently the goal in the field of standardization in artificial intelligence, i.e. how to solve issues of safety, ethics, transparency, quality, risk management and other issues related to artificial intelligence systems, important for the organizations that use those systems, as well as their application in other sectors of the economy.

Key Words: Artificial intelligence, Standardization, ISO/IEC, ITU, IEEE, CEN-CENELEC

1. INTRODUCTION

Artificial intelligence is becoming increasingly relevant as a topic, but also as a part of modern systems, including social and technological systems. Artificial intelligence is used in industry, healthcare, education and other areas. In order to ensure safety, transparency and accountability in the use of artificial intelligence, it is necessary to include standardization in its work.

To ensure ethical, technical and other types of security, standardization can serve as the most important and reliable tool. Organizations that develop standards, such as ISO, IEC, IEEE and CEN-CENELEC, are key in the standardization process when considering the process of developing different types of standards related to security, transparency, ethics, risk, systems and other aspects of artificial intelligence.

The aim of this paper is to present current standards in the field of artificial intelligence, related standards that have been developed, as well as standards in development. The paper first explains the basic

concepts related to this field, then explains the activities of the organization and systematizes the documents of these standardization bodies.

2. WHAT IS AI?

In 1955, John McCarthy and Marvin Minsky gave the definition of artificial intelligence where artificial intelligence was described as that there is an assumed possibility for creation of a specific type of machine that can simulate any type of learning or other characteristic of intelligence which can be precisely described [1]. Association for the Advancement of Artificial Intelligence in 2022. defined AI as materialized in machines, that is „scientific understanding of the mechanisms“ which essentially constitute intelligent behaviour and thought [1]. When we say intelligent behaviour, we cannot ignore the possibility of learning. Learning by trial and error is one of the simplest forms of learning applied to artificial intelligence [2].

In IBM article AI was described as: „Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy“ [3].

3. THE ROLE OF STANDARDIZATION IN AI

There is active standardization work when it comes to structuring the AI landscape and creating a framework for action together with stakeholders and

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experts from different fields of work [4]. „The aim is to use standards and specifications to strengthen trust in and acceptance of AI in industry and society“ [4]. This work is most important in the area of quality, security, reliability, transparency and traceability of AI applications [4].

The whole society, including companies, when using AI has great possible benefits, but also risks [5]. It is the standards that help to reduce that risk and increase the reward, because they improve the transparency and quality of data and the reliability of the system [5].

Gaps in regulations can be bridged by them, due to the ethical and social results that concern the demands of interested parties [5]. As stated above, artificial intelligence is also defined as the ability of machines to imitate human thinking, related to that, it follows that it is enabled to learn.

Accordingly, the question can be raised as to: what the standards would be that would enable AI to learn [6]. This issue is complicated by the fact that the ISO organization for „learn“ alone has over 100 variants of the term that are associated with already existing standards [6].

Increasingly, there are concerns about the possible lack of transparency regarding the functioning of gen AI systems (which can create new content, images, audio, code, text, videos and simulations) due to the increasing prevalence of artificial intelligence itself, and there are issues such as fairness and bias, possible violations of intellectual property and violations of privacy [7, 8].

Although artificial intelligence is not mature enough, the development of standards concerning artificial intelligence technologies is underway, that means, that the international standardization of this area „already has work to do and already does that work“ [9].

As artificial intelligence affects the whole world as a global phenomenon without borders, „national standardizing initiatives are more valuable being taken up at international level“ [9].

The following figure shows the number of working, study, „focus groups, community groups, committees and initiatives related to the field of standardization in artificial intelligence“ of the IEEE, ISO/IEC, ETSI, ITU-T and CEN/CENELEC organizations in 2020 [10].

In 2019, IEEE had 14 working groups and every group was focusing on each distinct standard. Then, ISO had 10 working groups but now, as written in the text below, ISO has 14 working groups in JTC 1/SC 42 and 39 published standards within that subcommittee [11].

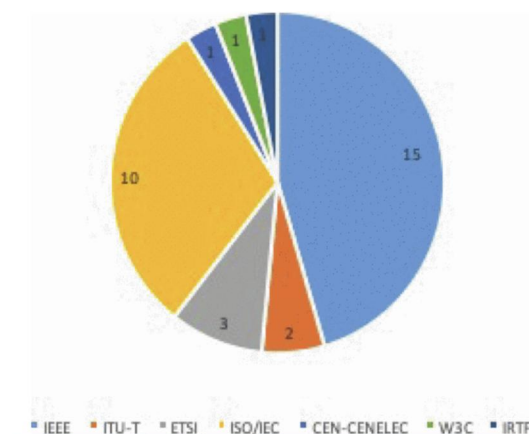


Figure 1 - Number of groups active in field of standardization or similar activities per organization that delivers or adopts and sets standards [10]

4. ISO AND IEC TOP STANDARDS IN AI OVERVIEW

ISO (International Organization for Standardization) is a non-governmental organization created in 1947 [12]. It has 173 members, 829 committees and subcommittees and 26.010 international standards and other deliverables [12]. IEC is International Electrotechnical Commission, with around 170 members (country members), and more than 10.000 developed international standards [13].

Within the framework of the ISO and IEC organizations, the joint technical committee JTC 1 for information technology standardization was created in 1987 [14]. Within this technical committee there are 24 subcommittees and 17 working groups and within it 3639 standards were developed and published, of which 543 are under the direct responsibility of this committee [14]. Subcommittee 42 within this joint technical committee deals with standardization in the area of artificial intelligence [11]. This subcommittee was created in 2017 with headquarters in the United States. There are 14 working groups and so far 39 standards have been published within this subcommittee [11].

The following standards within the ISO organization that are defined as Top Standards are listed in the text below [5]:

- ISO/IEC 22989- Information technology – Artificial intelligence - Artificial intelligence concepts and terminology

This document applies regardless of the type of organization, and refers to the terms and describes the concepts of artificial intelligence and can be used during the development of other standards or for communication between shareholders and interested parties [15].

- ISO/IEC 42001 - Information technology - Artificial intelligence - Management system

This standard applies to companies of any size, entities that use or provide products or services based on artificial intelligence, so as to ensure responsible development and use of it [16]. It is the first international standard of the artificial intelligence management system with valuable guidelines in that field and deals with issues of ethics, continuous learning and transparency [16]. The benefits offered by this standard are the reduction of costs, the offered framework related to opportunities and risk management and the demonstration of the responsible use of artificial intelligence [16].

- ISO/IEC 42005 - Information technology – Artificial intelligence (AI) - AI system impact assessment

This standard provides guidelines for organizations for recognizing the impact assessment of artificial intelligence systems with its predictable applications on individuals, groups or society [17]. It supports accountability, transparency and trust in artificial intelligence „by helping organizations identify, evaluate and document potential impacts throughout the AI system lifecycle“ [17].

The standard can play a role in addressing the impact of artificial intelligence on ethical, environmental and social issues. It helps organizations align the development of artificial intelligence with security, fairness and human-centered design [17].

- ISO/IEC 42006 - Information technology – Artificial intelligence - Requirements for bodies providing audit and certification of artificial intelligence management systems

This standard is an addition to the requirements of the ISO 42001 standard, which helps auditors and bodies for the standardization of management systems to perform these tasks reliably and consistently, thus enabling interested parties and customers to have confidence in the fulfillment of the requirements of the ISO 42001 standard, according to which organizations are certified [18]. It ensures that work is done with the necessary rigor because it builds on the standard ISO 17021/-1 [18].

- ISO/IEC 23894 - Information technology - Artificial intelligence - Guidance on risk management

This document serves to provide guidelines for risk management of organizations that produce, develop, implement or use service systems or products that use artificial intelligence [19]. It is intended for any organization, and serves for the effective integration and implementation of AI risk management [19].

- ISO/IEC 38507- Information technology - Governance of IT - Governance implications of the use of artificial intelligence by organizations

This document is intended for the general community and executive managers, technical experts, policy makers or public authorities and auditors. It can be applied to any organization, to manage the current and future „use of artificial intelligence, in order to ensure its effective, efficient and acceptable use“ in the organization [20].

- ISO/IEC 5338 - Information technology - Artificial intelligence - AI system life cycle processes

This document serves to describe the life cycle of an organization's AI system by defining a set of related processes and concepts. „It is based on ISO/-IEC/IEEE 15288 and ISO/IEC/IEEE 12207“ [21].

5. ITU ACTIVITIES AND RECOMMENDATIONS OVERVIEW

The International Telecommunication Union published around 100 standards which are AI related [22]. Currently, together with published standards and standards in development, this organization has over 220 standards related to AI [22]. These documents include „standard frameworks to integrate AI/ML in networks, standard terms and definitions, standards to evaluate AI/ML models and their results, standards for data handling“ [22].

Also within this organization, partnerships are created that are the foundations of new AI standards for health, digital agriculture and disaster management [22].

These are some of the ITU recommendations that are related to artificial intelligence:

- Architectural framework for machine learning in future networks including IMT-2020 [23]

This recommendation is an „architectural form for machine learning in future networks“ and IMT-2020 [23]. Includes ML pipelines, ML management, and ML orchestration [23].

- Framework for evaluating intelligence levels of future networks including IMT-2020 [24]

This recommendation determines the framework for assessing „the intelligence of future networks, including IMT-2020“ [24].

- Machine learning marketplace integration in future networks including IMT-2020 [25]

Recommendation for high-level requirements and integration of machine learning „in future networks, including IMT-2020“ [25].

- Architectural framework for machine learning sandbox in future networks including IMT-2020 [26]

This recommendation describes the high-level requirements and architecture for ML „sandbox“ „in future networks, including IMT-2020“ [26]

6. IEEE AI STANDARDS COMMITTEE

IEEE „is a global community for technologists, helping to shape the systems and standards of tomorrow“ [27]. Within it, there is the IEEE AI Standards Committee, which is responsible for standards for the management and operation of artificial intelligence related to management and practices related to machine learning, the use of connected data, and algorithms [28]. By 2025, 12 standards related to artificial intelligence have been developed within IEEE AI, and the first one was published in 2020 [29].

These are some of the IEEE AI standards [29]:

- IEEE Standard for Technical Framework and Requirements of Trusted Execution Environment based Shared Machine Learning
- IEEE Standard for Performance Benchmarking for Artificial Intelligence Server Systems
- IEEE Standard for Robustness Testing and Evaluation of Artificial Intelligence (AI)-based Image Recognition Service
- Standard for Responsible AI Licensing
- Standard for Transparent Agency Identification of Humans and Machines

7. CEN-CENELEC JTC 21

CEN is the European Committee for Standardization which brings together 34 European national standardization bodies [30]. „CEN provides a platform for the development of European standards and other technical documents related to different types of products, materials, services and processes“ [30].

CENELEC, the European Committee for Electrotechnical Standardization which brings 34 European National Electrotechnical Committees [31]. „CENELEC prepares voluntary standards in the electrotechnical field, which help facilitate trade between countries, create new markets, cut compliance costs and support the development of a Single European Market“ [31].

These two committees formed the joint technical committee JTC 21, within which European standards for artificial intelligence are developed, as well as harmonized standards that support the EU AI Act [32].

Within JTC 21, societal and market needs for standardization in AI in Europe are being investigated. The goal is to support the implementation of EU laws, principles and policies, to develop standards that will be legally harmonized according to the law on AI. The goal is also to give instructions to other technical

committees working in the field of artificial intelligence. The goal is to adopt international standards and, when necessary, to develop European standards [32].

Currently, the main standards under development are [32]:

- AI Trustworthiness Framework.
- AI Risk Management: Addressing operational risks.
- AI Quality Management System: Ensuring robust processes for AI development.
- AI Conformity Assessment: Facilitating compliance verification.

Within this committee, 15 standards were published, of which 9 were taken from ISO/IEC, and the remaining 6 are technical reports (TR) or technical specifications (TS) created by CEN/CENELEC [33].

8. CONCLUSION

One of the key factors for the safe and interoperable development of artificial intelligence at the global level is standardization in this area. The activities of organizations such as ISO, IEC, ITU, IEEE and CEN-CENELEC allow us to see that there are many standards in this area, as well as many standards in development that relate to ethical use, safe use, risk management and other issues related to the intelligence system.

From the work of the CEN/CENELEC committee dealing with artificial intelligence, we can conclude that many European standards are based on the standards of ISO and IEC organizations.

Artificial intelligence is rapidly advancing in terms of using its resources, that is, using its tools, technology and sites for more effective and efficient work. The future is likely to bring us greater risks when it comes to safety, ethics and quality when using artificial intelligence. As rapid changes occur, and in these organizations there are many working groups and standards and recommendations and technical specifications and reports that have been placed as well as those that are being prepared, standardization should progress in step with the events and changes in the market. Whether standardization will catch up with the development of artificial intelligence in a way that prevents all possible risks that may arise when using it, as well as whether and to what extent standardization will remain recognized by the organizations that need its application most, time will tell. For now, this is an overview of the most important committees working in this area, trying to reduce the problems that can arise from unethical, insufficiently careful or rigorous practices and actions, and insufficiently transparent and managed risks in relation to artificial intelligence through standardization.

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REZIME

STANDARDIZACIJA U OBLASTI VEŠTAČKE INTELIGENCIJE

Tema ovog rada je standardizacija u oblasti veštačke inteligencije. Istražuje se problem obuhvatanja ove oblasti standardima od strane vodećih međunarodnih i evropskih organizacija za standardizaciju. U radu su razmotreni određeni važni standardi, preporuke, tehnički izveštaji i tehničke specifikacije, i predstavljen je prostor i domen njihove primene. Objašnjena je mogućnost primene, kao i prikaz okvira (landscape) standardizacije u oblasti veštačke inteligencije. Predstavljene su standardi u pripremi, kao i objavljeni standardi najznačajnijih međunarodnih i evropskih organizacija: ISO, IEC, ITU, IEEE i CEN-CENELEC. Rad pokazuje šta je trenutni cilj u oblasti standardizacije veštačke inteligencije, odnosno kako rešiti pitanja bezbednosti, etike, transparentnosti, kvaliteta, upravljanja rizikom i druga pitanja povezana sa sistemima veštačke inteligencije koja su važna za organizacije koje koriste te sisteme, kao i njihovu primenu u drugim sektorima privrede.

Ključne reči: *Veštačka inteligencija, standardizacija, ISO/IEC, ITU, IEEE, CEN-CENELEC*