



#### AI & ML and standardisation

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## **Standardisation bodies**





ASTM - American Society for Testing and Materials
ANSI - American National Standards Institute
BIPM - Bureau international des poids et mesures
BSI - British Standards Institution
CEN - Comité Européen de Normalisation
CENELEC - Comité Européen de Normalisation Électrotechnique
ETSI - European Telecommunications Standards Institute
IEC - The International Electrotechnical Commission
IEEE - Institute of Electrical and Electronics Engineers
IETF - Internet Engineering Task Force
ISO - International Telecommunication Union
SAE - Society of Automotive Engineers
W3C - The World Wide Web Consortium

The standards are not mandatory, but EU harmonised standards provide conformity to EU regulations; not following them could come with risks and costs

Some industries have their own de-facto standards outside of the standards organisations

## **Standardisation committees on Al**



ISO/IEC JTC1 SC42 (international)

- WG1: Foundational standards
- WG2: Data
- WG3: Trustworthiness
- WG4: Use cases and applications
- WG5: Computational approaches and computational characteristics of AI systems
- JWG: Governance implications of AI
- CEN-CENELEC JTC21 (European)
- BSI ART1 (UK national mirror committee); representatives of academia, industry (from corporations to SMEs), public services



LZZ ISO STANDARDS UNDER DEVELOPMENT \* under the direct responsibility of ISO/IEC JTC

1/SC 42

## **CEN/CENELEC Focus Group on AI – JTC21**



#### Towards the CEN-CENELEC Roadmap for AI standardization Investigating the standardization needs for AI deployment in Europe October 2019 February/March 2019 As from March 2019 ISO/IEC JTC 1/SC 42 plenary meeting in CEN and CENELEC Technical Boards (BTs) Liaising with relevant TCs, national Japan – taking stock of international meetings: secretariat allocation and European stakeholders, the EC, activities outcomes and presenting the the High-Level expert group draft CEN-CENELEC roadmap outcomes 0\_0 000\_0 0\_0 0\_0 Q1 2020 December 2018 March 2019 October 2019 Deliver the final AI standardization Roadmap. Presentation of the Kick-off meeting, decision on the CEN and CENELEC Technical CEN and CENELEC officially recommendations to international terms of reference, work created the Focus Group on AI, Boards meeting - first report of programme, objectives, structure standardization, European technical the Focus Group in support of ISO/IEC JTC 1 SC 42 committees, European Policy makers and convenorship

September 2020: issued a response document on the EC White Paper on AI

New JTC21 on AI – started working in 2021

Draft Al Act of EC, April 2021: proposal of a harmonised Al standard to ensure safety and attribute liability of Al systems.

## How standards are organised

For	ewordv				
Introductionvi					
1	Scope1				
2	Normative references1				
3	Terms and definitions1				
4	Symbols and abbreviated terms9				
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#### 3.37 reliability

property of consistent intended behaviour and results [SOURCE: ISO/IEC 27000:2016, 2.56]

3.50 trustworthiness quality of being dependable and reliable [SOURCE: ISO 17068:2017, 3.18]

#### 3.5.1 robustness

ability of a system to maintain its level of performance under any circumstances

#### 3.2.2

#### artificial intelligence

<system>capability of an engineered system to acquire, process and apply knowledge and skills

#### 3.2.3

#### artificial intelligence

<engineering discipline>discipline which studies the engineering of systems with the capability to acquire, process and apply knowledge and skills



#### How standard are developed



PRIVATE CIRCULATION ART/1\_20\_0411

information

Project: ISO/IEC CD 22989

Ballot: ISO/IEC CD 22989.2

Template for comments and secretariat observations

Date: XXXX

Document: XXXX

MB/ NC <sup>1</sup>	Line number (e.g. 17)	Clause/ Subclause (e.g. 3.1)	Paragraph/ Figure/ Table/ (e.g. Table 1)	Type of comment <sup>2</sup>	Comments	Proposed change	Observations of the secretariat
KMS /1				ge	The standard does not clearly and consistently distinguish human knowledge from machine knowledge. This is important because confusion between the two will lead to unrealistic expectations of AI and ML, with potentially serious consequences (especially where these expectations inform policy decisions). For example: if machines can interpret chest x-rays, will we stop training radiologists? If we stop training radiologists, who will have the human knowledge to retrain machines in the future?	Most of the following comments are intended to address this issue.	
KMS /1	118 to 120	Introduction		te	This is a crucial point, but there is a risk that it will be missed and the terms will be interpreted in the context of their general language dictionary meanings.	Move these lines to a more prominent position in the Introduction (e.g. after the first paragraph so that the message is before the first occurrence of 'knowledge' in line 107) and delete the word 'Note'.	
KMS /1		3.12		te	The term <i>knowledge</i> could be interpreted as referring to <i>human knowledge</i> .	Change knowledge to machine knowledge.	
KMS /1		3.15		te	Knowledge is not the same as information. Like 'understanding' (see clause 7.1), only humans (and possibly other living beings– but this is probably not relevant here) are capable of 'knowing' (which is a close synonym of 'understanding') and therefore of knowledge.	Rename the term <i>knowledge</i> to <i>machine</i> <i>knowledge</i> . This probably makes ' <artificial intelligence&gt;' redundant.</artificial 	
					The 'knowledge' in AI systems should be distinguished from human knowledge by calling it <i>machine knowledge</i> (which aims to simulate human knowledge).		

In the year of Covid19, meetings are online; challenges of reduced communications

## **Stages of ISO standards development**



STACE	CURCTACE			90			
STAGE	SUBSTAGE		DECISION				
	00 REGISTRATION	20 START OF MAIN ACTION	60 COMPLETION OF MAIN ACTION	<b>92</b> Repeat an earlier phase	<b>93</b> REPEAT CURRENT PHASE	98 Abandon	<b>99</b> PROCEED
00 PRELIMINARY	<b>00.00</b> Proposal for new project received	<b>00.20</b> Proposal for new project under review	<b>00.60</b> Close of review			<b>00.98</b> Proposal for new project abandoned	<b>00.99</b> Approval to ballot proposal for new project
10 proposal	<b>10.00</b> Proposal for new project registered	<b>10.20</b> New project ballot initiated	<b>10.60</b> Close of voting	<b>10.92</b> Proposal returned to submitter for further definition		10.98 New project rejected	<b>10.99</b> New project approved
20 PREPARATORY	<b>20.00</b> New project registered in TC/SC work programme	<b>20.20</b> Working draft (WD) study initiated	<b>20.60</b> Close of comment period			20.98 Project deleted	<b>20.99</b> WD approved for registration as CD
30 committee	<b>30.00</b> Committee draft (CD) registered	<b>30.20</b> CD study/ballot initiated	<b>30.60</b> Close of voting/ comment period	<b>30.92</b> CD referred back to Working Group		<b>30.98</b> Project deleted	<b>30.99</b> CD approved for registration as DIS
40 ENQUIRY	<b>40.00</b> DIS registered	<b>40.20</b> DIS ballot initiated: 12 weeks	<b>40.60</b> Close of voting	<b>40.92</b> Full report circulated: DIS referred back to TC or SC	<b>40.93</b> Full report circulated: decision for new DIS ballot	<b>40.98</b> Project deleted	<b>40.99</b> Full report circulated: DIS approved for registration as FDIS
50 APPROVAL	<b>50.00</b> Final text received or FDIS registered for formal approval	<b>50.20</b> Proof sent to secretariat or FDIS ballot initiated: 8 weeks	<b>50.60</b> Close of voting. Proof returned by secretariat	<b>50.92</b> FDIS or proof referred back to TC or SC		50.98 Project deleted	<b>50.99</b> FDIS or proof approved for publication
60 PUBLICATION	<b>60.00</b> International Standard under publication		<b>60.60</b> International Standard published				
90 REVIEW		<b>90.20</b> International Standard under periodical review	90.60 Close of review	90.92 International Standard to be revised	<b>90.93</b> International Standard confirmed		<b>90.99</b> Withdrawal of International Standard proposed by TC or SC
95 withdrawal		<b>95.20</b> Withdrawal ballot initiated	<b>95.60</b> Close of voting	<b>95.92</b> Decision not to withdraw International Standard			<b>95.99</b> Withdrawal of International Standard



# Standards on trustworthiness, explainability, transparency, robustness



- ISO/IEC DIS 23053 Framework for artificial intelligence systems using machine learning
- ISO/IEC DIS 22989 Artificial Intelligence concepts and terminology
- ISO/IEC 24028 Overview of trustworthiness in artificial intelligence
- ISO/IEC 24029 Assessment of the robustness of neural networks
- ISO/IEC DTS 4213 Assessment of machine learning classification performance
- ISO/IEC AWI 5338 AI system life cycle processes
- ISO/IEC DTR 24027 Bias in AI systems and AI aided decision making
- ISO/IEC AWI 25059 Systems and software Quality Requirements and Evaluation (SQuaRE) Quality model for AI-based system

AWI - Approved new Work Item DIS - Draft International Standard DTS - Draft Technical Specification

Problem of discrepancies between WGs, plans to normalise this with establishment of shared libraries of terms

#### **Other activities and regulations, UK & EU**



- Artificial Intelligence and Public Standards, A Review by the UK Committee on Standards in Public Life, 2020
- Office for Artificial Intelligence, UK Department for Digital, Culture, Media & Sport and Department for Business, Energy & Industrial Strategy
- UK Centre for the Future of Intelligence, University of Cambridge
- Responsible AI Institute collaborates with IEEE and World Economic Forum, has about 2000 members, works with stakeholders and regulators
- German Standardization Roadmap, Standardisation Council Industrie 4.0, 2020
- Robustness and explainability of AI, Joint Research Centre, EC 2020

## **Standards relevant to Al**

Requirements	Data and data governance	Risk manageme nt system	Technical data and Record keeping	Transparency and information to users	Human oversight	Accuracy, robustness, and cybersecurity	Quality managemen system
SDO							
ISO and ISO/IEC JTC1	ISO/IEC 25024; ISO/IEC 5259; ISO/IEC 24668;	ISO/IEC 4213; ISO/IEC 25059; ISO/IEC 24029-2	ISO/IEC 5338; ISO/IEC 5469; ISO/IEC 24368; ISO/IEC 24372; ISO/IEC 24668	ISO/IEC 24027; ISO/IEC 24028; ISO/IEC 5338; ISO/IEC 24368; ISO/IEC 24372; ISO/IEC 24668; ISO/IEC 4213		ISO/IEC 24027; ISO/IEC 24028; ISO/IEC 24029; ISO/IEC 5469	ISO/IEC 23894; ISO/IEC 38507; ISO/IEC 42001; ISO/IEC 25059
IEEE	ECPAIS Bias; IEEE P7002; IEEE P7003; IEEE P7004; IEEE P7006; IEEE P7009; IEEE P7009; IEEE P2801; IEEE P2807; IEEE P2863	IEEE P7009; IEEE P2807; IEEE P2846	ECPAIS Transparency; IEEE P7000; IEEE P7006; IEEE P2801; IEEE P2802; IEEE P2807; IEEE P2863; IEEE P3333.1.3	ECPAIS Bias; ECPAIS Transparency; ECPAIS Accountability ; IEEE P7000; IEEE P7001; IEEE P7004; IEEE P7004; IEEE P7005; IEEE P7007; IEEE P7008; IEEE P7008; IEEE P7009; IEEE P7011; IEEE P7014; IEEE P7014; IEEE P2863; IEEE P3652.1	ECPAIS Accountability; ECPAIS Transparency; IEEE P7000; IEEE P7006; IEEE 7010; IEEE P7014; IEEE P2863	ECPAIS Transparency; IEEE P7007; IEEE P7009; IEEE P7012; IEEE P2802; IEEE P2807; IEEE P2846; IEEE P2863; IEEE P3333.1.3	IEEE 2801; IEEE P2863 IEEE P7000
ETSI	DES/eHEALTH- 008 ; GR CIM 007 ; GS CIM 009; ENI GS 001; GR NFV- IFA 041; DGR SAI 002; TR 103 674; TR 103 675; TS 103 327; TS 103 194; TS 103 195 2	GS ARF 003 ; GR CIM 007 ; ENI GS 005; GR NFV- IFA 041; DGS SAI 003; EG 203 341	DES/eHEALTH- 008 ; ENI GS 005 ; DGR SAI 002, SAREF Ontologies; GR CIM 007; GS CIM 009	DES/eHEALTH -008 ; GS CIM 009 ; DGR SAI 002; SAREF Ontology	DES/eHEALTH- 008 ; DGR SAI 005	GS ARF 003 ; GR CIM 007 ; ENI GS 001; ENI GR 007 ; DGR SAI 001; DGR SAI 002; DGS SAI 003; GR SAI 004; GS ZSM 002; TR 103 674; TR 103 675; TS 103 327	

UK committee in discussion: "Multiplicity of standards from different organizations, with different terms, definitions and concepts, is a threat to the building of a European ecosystem of trust. Coordination work is necessary, otherwise it may prove impossible for SMEs and innovators to select appropriate standards. CEN-**CENELEC** collaborates with ETSI and other organisations to address this."

Nativi S., De Nigris S., Al Watch: Al Standardisation Landscape - state of play and link to the EC proposal for an Al regulatory framework, JRC 2021





## Example of an AI application with standardisation & policy integration: Building Management Systems

- PhD project (2018-2020)
- Joint with Brunel University and Mitie company (BMS management)
- Access to live data in control room and customers profiles (Rolls Royce, Vodafone)
- Modelled Triad Demand Side Response (UK DSR), in winter season 2019-2020
- Achieved 45K GBP savings for Rolls Royce by successful Triad forecast using LSTM deep neural network
- Automated sensor tagging according to Haystack BMS standard
- Modelled long-term energy demand with renewables integration using power purchase agreements (PPA)

## **Net-Zero BMS with AI solutions**





Optimisation of energy consumption with automation of BMS rules

Use of demand-side response (DSR) with modelled demand forecasts

Optimisation of indoor ventilation for Covid19related conditions

Long-term forecast of energy demand for renewable energy trading (PPA)

Balancing energy consumption and operational carbon savings

Contributed to a recent parliamentary POSTnote on energy sector digitalisation Submitted EMPIR PRT for Green call; plan another for Digital

## Papers on ML & Al and standards



- 1. Standardisation of Artificial Intelligence: Making a "New World" Brave, with Support of Human Requirements in a New Machine Intelligence Environment, *submitted*
- 2. Long-Term Wind and Solar Energy Generation and Optimisation of Power Purchase Agreements, *submitted*
- 3. Linking Air Handling Units for Optimal Energy Control, in revision
- 4. Early Warning Signals of Failures in Building Management Systems, International Journal of Metrology and Quality Engineering, in press
- 5. Al and sustainability, AHG report, CEN-CENELEC JTC21 (2021)
- 6. Machine learning for BMS analysis and optimisation, *Engineering Research Express* 2, 045003 (2020)
- 7. Modelling Demand Response Interventions with Long-Short-Term-Memory Networks, *Energy Efficiency* 13, 1263-1280 (2020)





- Al standardisation is in its early stages (the field develops fast; standardisation has its own timeline)
- For main definitions, ISO/IEC DIS 22989 is useful for broad audience
- If you develop AI solutions, have a look at relevant standards on robustness, trustworthiness and quality control
- Some of the standards are available under organisational subscription, some early drafts can be accessed via committee membership
- AI standardisation is multi-faceted: it addresses technical issues as well as legal, ethical, corporate, national & international (GDPR for EU, Net-Zero Carbon Emissions Target for the UK)





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