Use cases and AI application guidelines in international standardization

Dr. Fumihiro Maruyama

Convenor, SC 42/WG 4

National Institute of Advanced Industrial Science and Technology

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS
SC 42 – Artificial Intelligence

Introduction

- SC 42/WG 4
- AI use cases (ISO/IEC TR 24030)
- Guidelines for AI applications (ISO/IEC CD 5339)
- AI system life cycle processes (ISO/IEC CD 5338)

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS
SC 42 – Artificial Intelligence

Structure of SC 42

WG 1	Foundational standards
WG 2	Big data
WG 3	Trustworthiness
WG 4	Use cases and applications
WG 5	Computational approaches and computational characteristics of AI systems
JWG 1	JWG SC 42 – SC 40: Governance implications of AI
JWG 2	JWG SC 42 – SC 7: Testing of AI-based systems
AG 3	AI standardization roadmapping
AHG 1	Dissemination and outreach
AHG 2	Liaison with JTC 1/SC 38
AHG 4	Liaison with JTC 1/SC 27

SC 42/WG 4 “Use cases and applications”

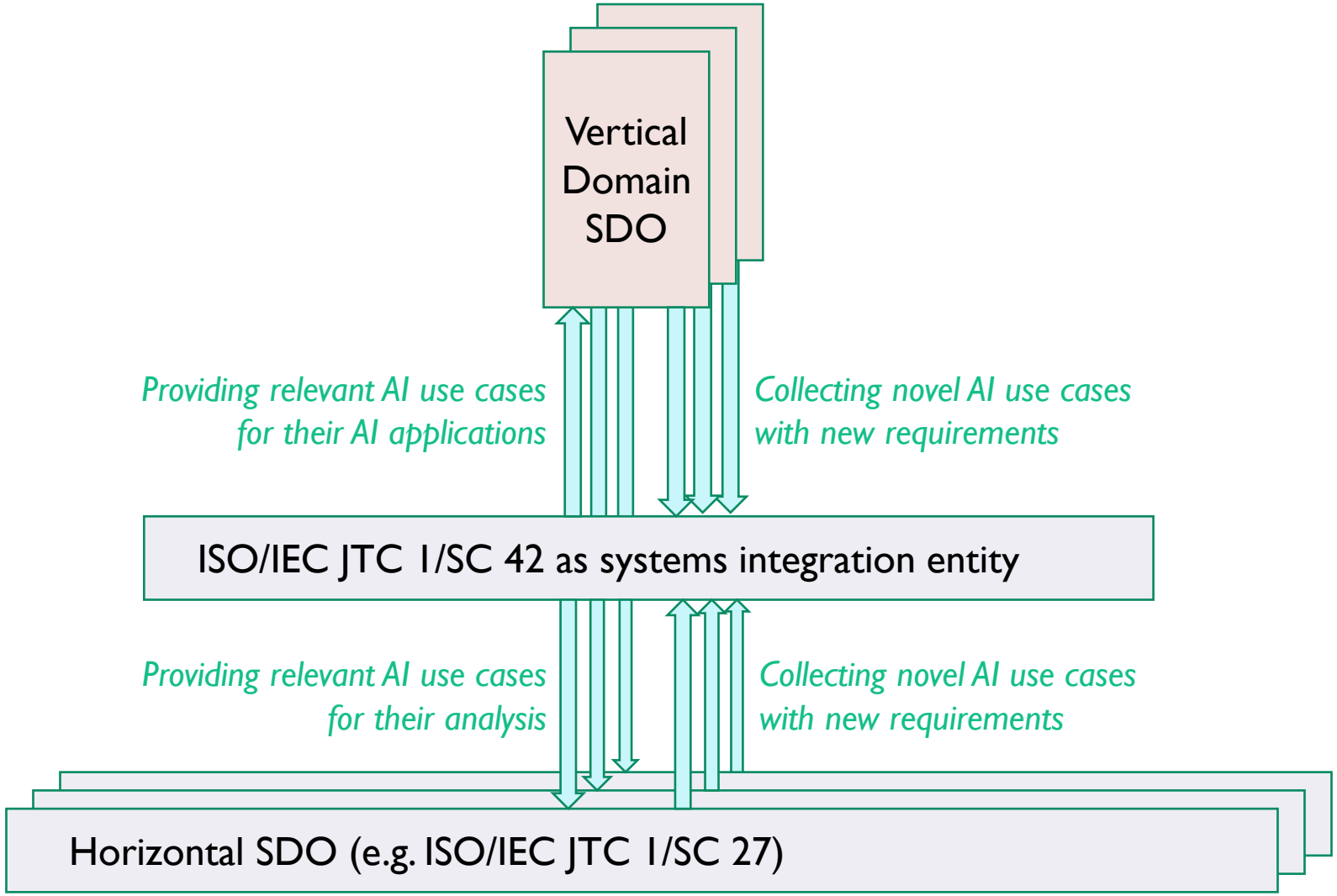
- Overview
  - Identify AI application domains, context of AI use in those domains and develop guidance
  - Collect representative use cases and analyze them for derived requirements
- Officers
  - Convenor: Fumi Maruyama
  - Secretary: Nobu Hosokawa
  - Project Editors:
    - Yuchang Cheng (ISO/IEC CD 5338 – AI system life cycle processes, ISO/IEC TR 24030 – Use cases)
    - Shrikant Bhat (ISO/IEC CD 5339 – Guidelines for AI applications)

ISO/IEC TR 24030 Artificial Intelligence – Use cases

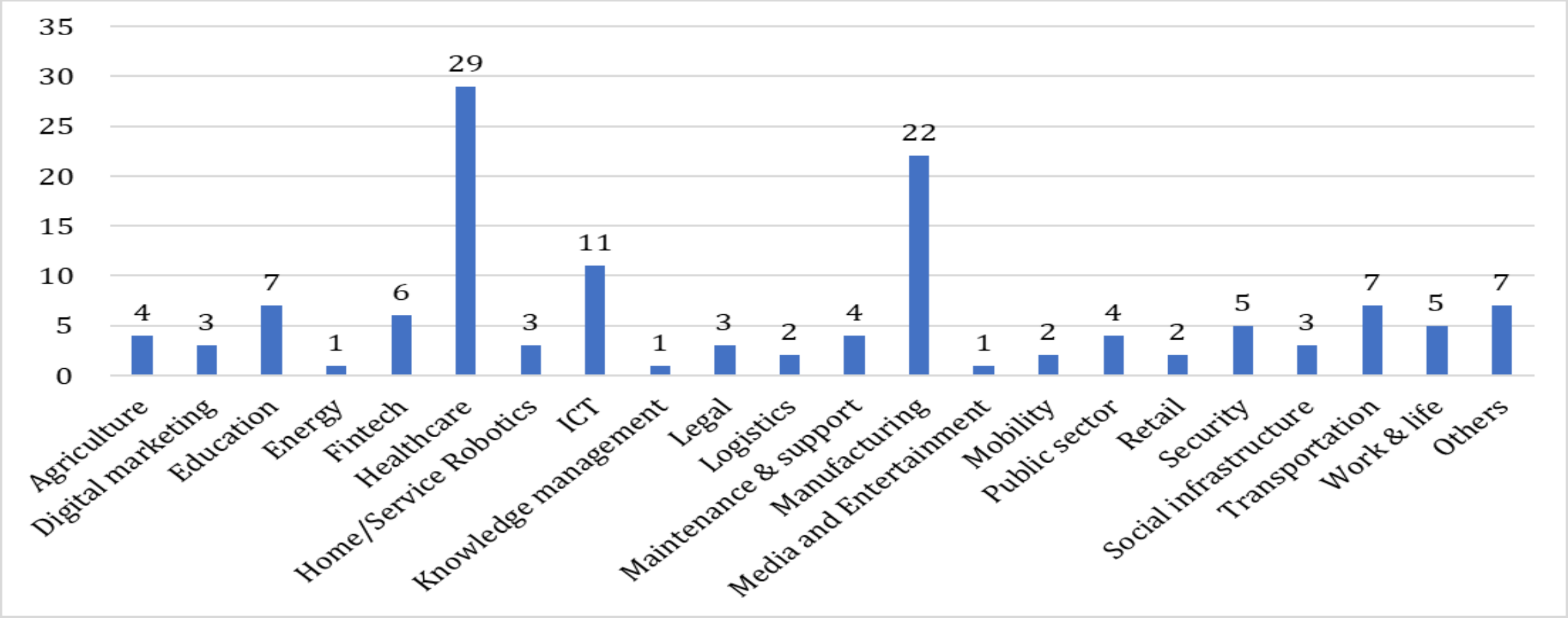
- Technical report with 132 use cases from NBs and liaison organizations
  - Main body with 100+ pages including use case summaries
  - Use case details with 360+ pages in electronic attachment
- Published in May 2021.
- Utilization of use cases
  - Provided vertical domain SDOs with use cases in their domain
  - SDOs took the use cases and analyzed them for their purpose
    - PWI 6089 - Impact of AI on security and privacy by ISO/IEC JTC 1/SC 27/WG 5

SDO: Standards Developing Organization

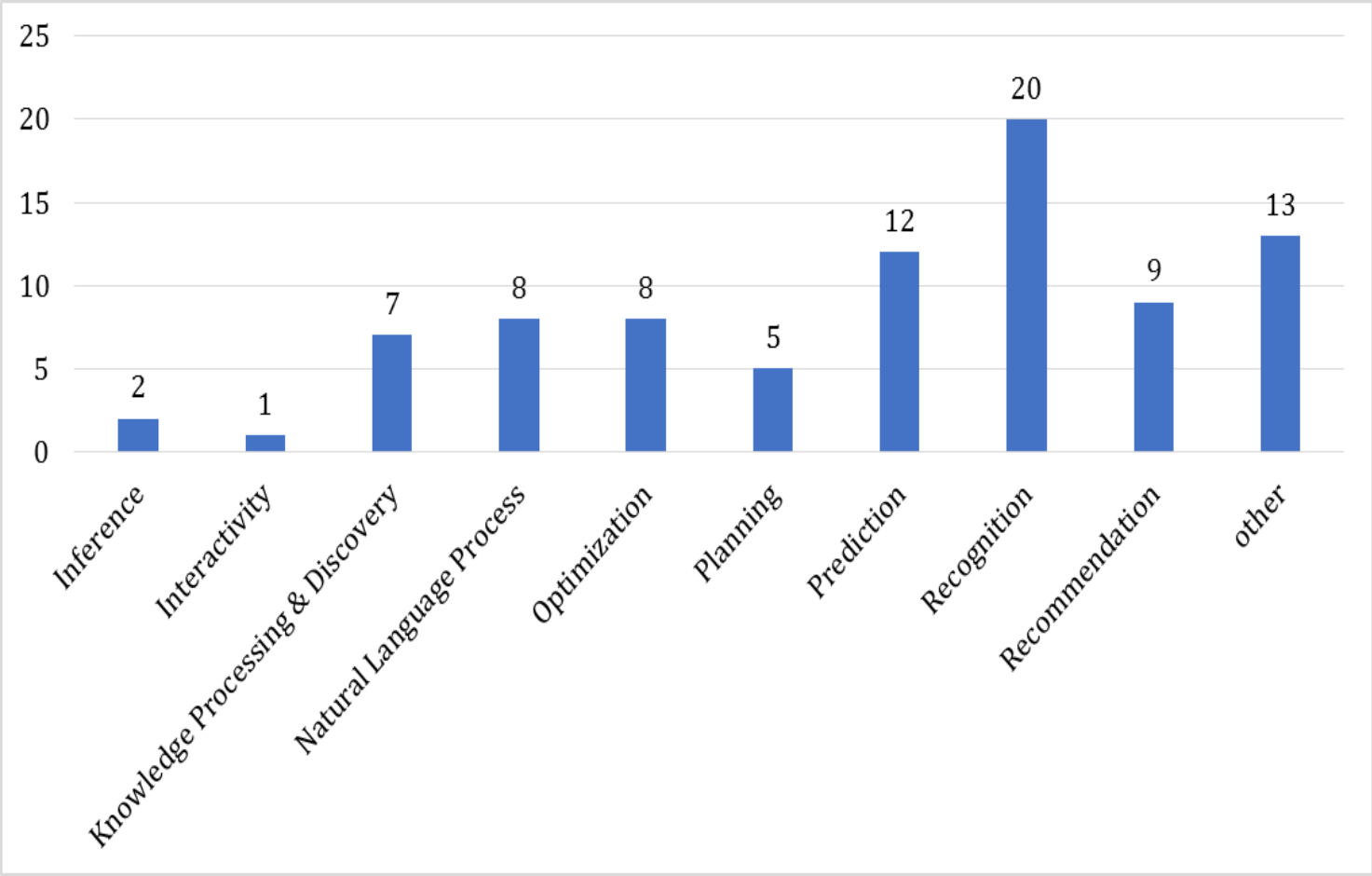
Collaboration through exchange of AI use cases



Application domain



AI task


25
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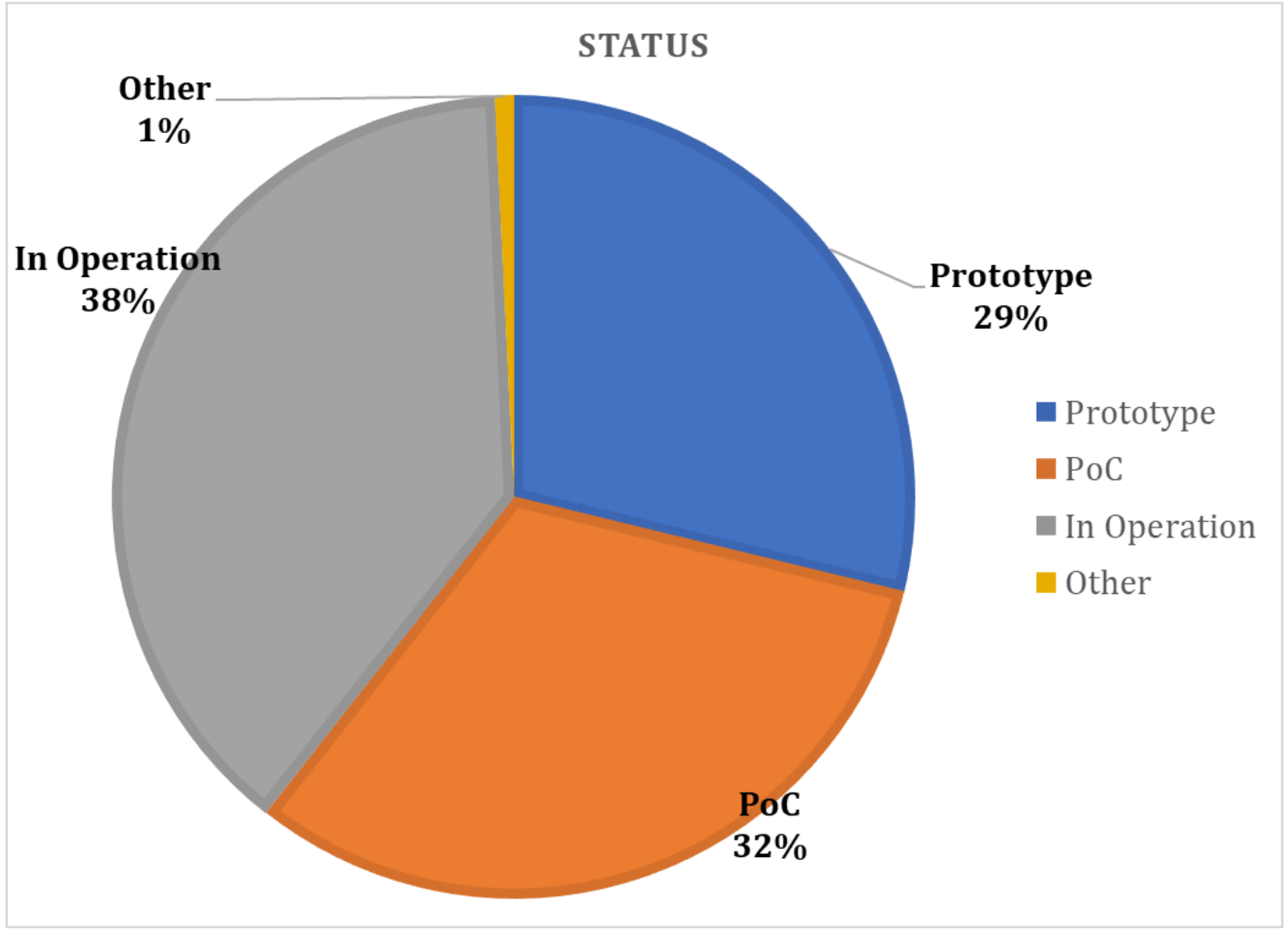
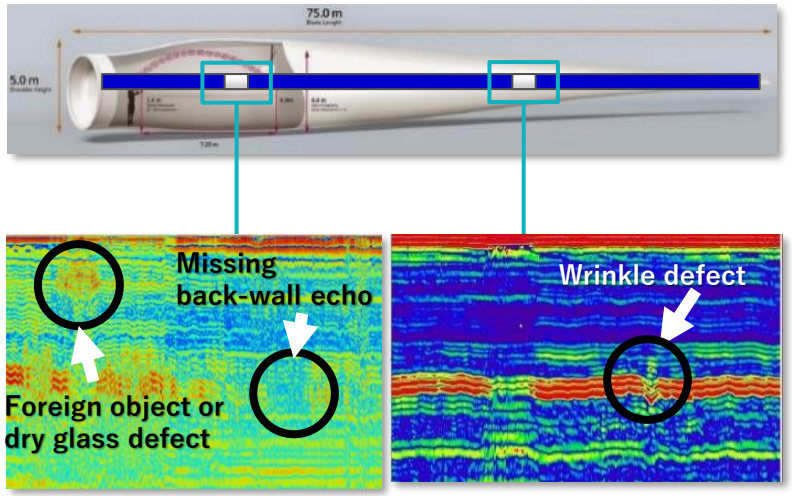
Inference
Interactivity
Knowledge Processing & Discovery
Natural Language Process
Optimization
Planning
Prediction
Recognition
Recommendation
other

Use case status



Example use case “AI solution to quickly identify defects during quality assurance process on wind turbine blades”

- AI system automatically detects defects from ultrasonic testing scanning data through deep learning capabilities.
  - It achieved high coverage (more than 95%) of various defects.
- Human inspectors only need to examine the parts of the blade that are flagged by the AI system.
- This solution enabled the same inspector to do 4 to 5 blades per day instead of 1 previously.



Example use case in template (1 of 3)

1.ID	4
2. Use case name	Detecting defects during quality assurance process on wind turbine blades
3. Application domain	manufacturing
4. Deployment model	on-premise systems
5. Objective(s)	To find an accurate and efficient solution to detect defects without compromising the detection of in-material damage and risking a loss in the manufacturer's reputation.
6. Narrative	This AI solution can automatically detect defects in produced wind turbine blades through "imagification", which transforms raw data from the non-destructive ultrasonic testing (UT) scanner into image data based on RGB where deep learning-based image recognition can be applied effectively. It achieved high coverage (see 9. KPIs) of more than 95 % for various defects, e.g. detecting missing back wall echo, foreign objects, dry glass defects and wrinkle defects. Quality controllers can focus their efforts on suspicious regions and disregard all clean data; humans are only expected to examine the regions of blades that are flagged as suspicious by the AI solution. Since it achieved low split (see 9. KPIs) of less than 20 %, it reduced evaluation time for UT scanning data by 80 %. Each blade can be up to 75 meters in length and takes a highly skilled professional quality controller up to 6 hours to evaluate the UT scanning data in the quality assurance process. With 5,000 blades produced every year, that adds up to a saving of almost 32,000 person-hours, which translates into significant cost savings, reduced production lead times, and increased productivity. Today, there is a shortage of ultrasonic engineers and inspectors. This solution enabled the same inspector to do four to five blades per day instead of one previously.

Example use case in template (2 of 3)

7. Stakeholders and stakeholder considerations	The manufacturer is the customer who wants to enhance the efficiency of the quality assurance process on wind turbine blades while maintaining the quality level of the products. The actual users of the solution are quality controllers and inspectors of produced wind turbine blades. The producer is responsible for deploying an AI solution capable of solving the above problem of efficiency. The provider is responsible for developing an AI system for the solution. Other stakeholders include utility companies and neighborhood communities.
8. Data Characteristics	UT Scanning Data Source: UT scanner Type: ultrasonic data from scanner vendor Velocity: batch Variety: single source Variability: static Quality: high
9. Key performance indicators (KPIs)	Coverage (for accuracy): Proportion of the defects automatically reported without manual inspection. Ideal target is 95 %. Split (for efficiency): Proportion of the regions of the blade that are flagged as suspicious and asking for manual inspection. The less split, the more efficient the total quality assurance process becomes.

Example use case in template (3 of 3)

10. Features of use case	Task(s)	recognition
	Level of automation	partial automation
	Method(s)	deep learning
	Platform	deep neural network
	Topology	convolutional neural network
11. Threats & vulnerabilities	Changes in defects of in-material damage over time	
12. Challenges and issues	Challenges: Achieve the same level as ultrasonic accredited engineers for detecting critical defects. Issues: – lack of defect data per defect type; – how to create good images for deep learning from UT raw data; – back wall detection.	
13. Trustworthiness considerations	The solution does not have 100 % reliability. That is where human-machine teaming comes into play. It also lacks robustness and resilience. That is why it needs continuous validation (monitoring and retraining). Although the solution lacks explainability, the human-machine team has explainability, i.e. the human quality controller and inspector can explain on behalf of the team.	
14. Use of standards; standardization opportunities	This use case is a good example of human-machine teaming. It provides standardization opportunities for empowerment and escalation for human-machine teaming.	
15. Relevant SDGs	Affordable and clean energy	

Revision of ISO/IEC TR 24030

- Scope: This document provides a collection of representative use cases of AI applications in a variety of domains. (unchanged)
- Time period: 18 months from November 2021
- Rationale:

  1) More use cases should be collected to cover more domains and contexts. We have already received additional use cases. More NBs and liaison organizations are expected to contribute new use cases.

  2) "In operation" use cases in TR 24030:2021 will be migrated to the updated template where possible.

  3) Recent use cases should be collected.

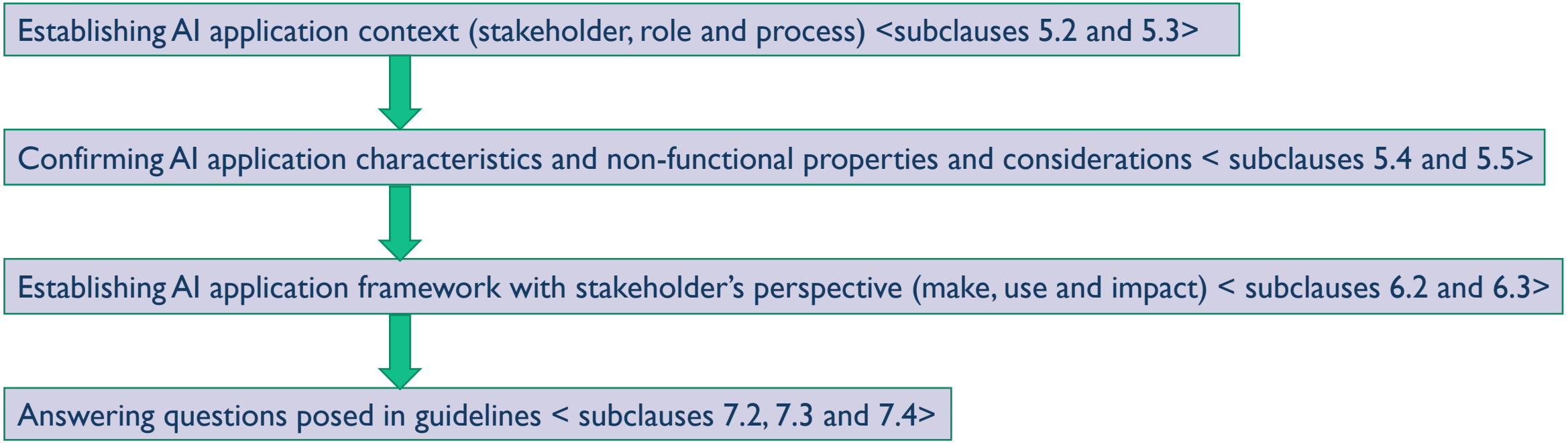
ISO/IEC TR 24030 ed.2

- Finished the first-round use case collection in February 2022 with the updated use case template.
- Started the second-round use case collection with the deadline of 30th June 2022.
- Seeking recent in-operation use cases with emphasis on the following application domains that are underrepresented by the current set of use cases:
  - *Construction, Digital Marketing, Home/Service Robotics, Knowledge Management, Legal, Logistics, Low-Resource Communities, Media and Entertainment, Mobility, Security*

ISO/IEC CD 5339 – Guidelines for AI applications

- Provides a macro-level view of an AI application to facilitate its understanding, development and use among all stakeholders.
- Includes:
  - Approach to identifying an AI application's stakeholders, context, functional characteristics and non-functional characteristics;
  - AI application framework that can be used to answer the question: "What are the characteristics and considerations of an AI application?";
  - Guidelines for AI applications based on the make, use and impact perspectives.
- Should be the first document to refer to when developing/using an AI application.
  - Provides references to relevant standards SC 42 and other SDOs are developing.

Developing/using an AI application with ISO/IEC 5339



AI application framework

Perspectives		*Make*	*Use*	*Impact*
Stakeholders		Table 1 (1 of 2)		Table 1 (2 of 2)
Context	Who			
	What			
	How			
	When			
	Where			
	Why			
	Subclause references			
All non-functional	Properties			
	Considerations			
Subclause references				

● = Stakeholder's role(s) in context

AI Characteristics	Processes	What	How	Subclause references
Table 2				

Example use case in framework (1 of 3)

Perspectives		Make			
Stakeholders		AI producers	Data providers	AI developers	AI application providers
Context	Who	Fujitsu Limited	Ultrasonic scanner vendor	Fujitsu Limited	Fujitsu Limited
	What	Responsible for the entire system	Provides data from ultrasonic scanners	Develops the AI system including the trained model	Takes the developed AI system and provides it as an AI application
	How	Built, Applies, Updated	Built	Built	Built
	When	All Stages	Design, Develop, Verify, Validate	Design, Develop, Verify, Validate	Deploy, Operate, Monitor
	Where		Producer	Producer	Customer Premises
	Why	The producer is expected to provide a good AI application for the customer because of a good understanding of the objective and requirements of the AI application through dialogues with the customer.			

Example use case in framework (2 of 3)

Perspectives		Use		Impact	
Stakeholders		AI customers	AI users	Community	AI regulators and policy makers
Context	Who	Wind turbine manufacturer	Professional quality controller, inspector of manufacturer	Utility companies, users and neighbours of wind turbine	European Commission's Director-General (DG) for Internal Market, Industry, Entrepreneurship and SMEs
	What				
	How	Applies	Applies		
	When	Deploy, Operate, Monitor	Deploy, Operate, Monitor	Deploy, Operate, Monitor	Deploy, Operate, Monitor
	Where	Customer Premises	Customer Premises		
	Why	Any defects when a blade is in operation will not only prove catastrophic but also inflict major damage to the manufacturer's reputation. The manufacturer produces over 5,000 wind turbine blades every year for use in on and off shore wind farms. Each blade can be up to 75 meters in length and takes a highly skilled professional quality controller up to 6 hours to evaluate the scanning data in the quality assurance process. With the AI system the evaluation time is reduced by 80%, which translates into cost savings, reduced production lead times, and increased productivity.	Professional quality controllers and inspectors of the manufacturer are interested in their increased productivity with the AI application as well as the performance (accuracy) of the AI application.	Neighbours of the wind turbine sites are apprehensive about any damage caused by a defective wind turbine.	The regulator makes sure of safety of products with the regulations for manufacturing process of huge products such as wind turbine blades and liability of defective products.

Example use case in framework (3 of 3)

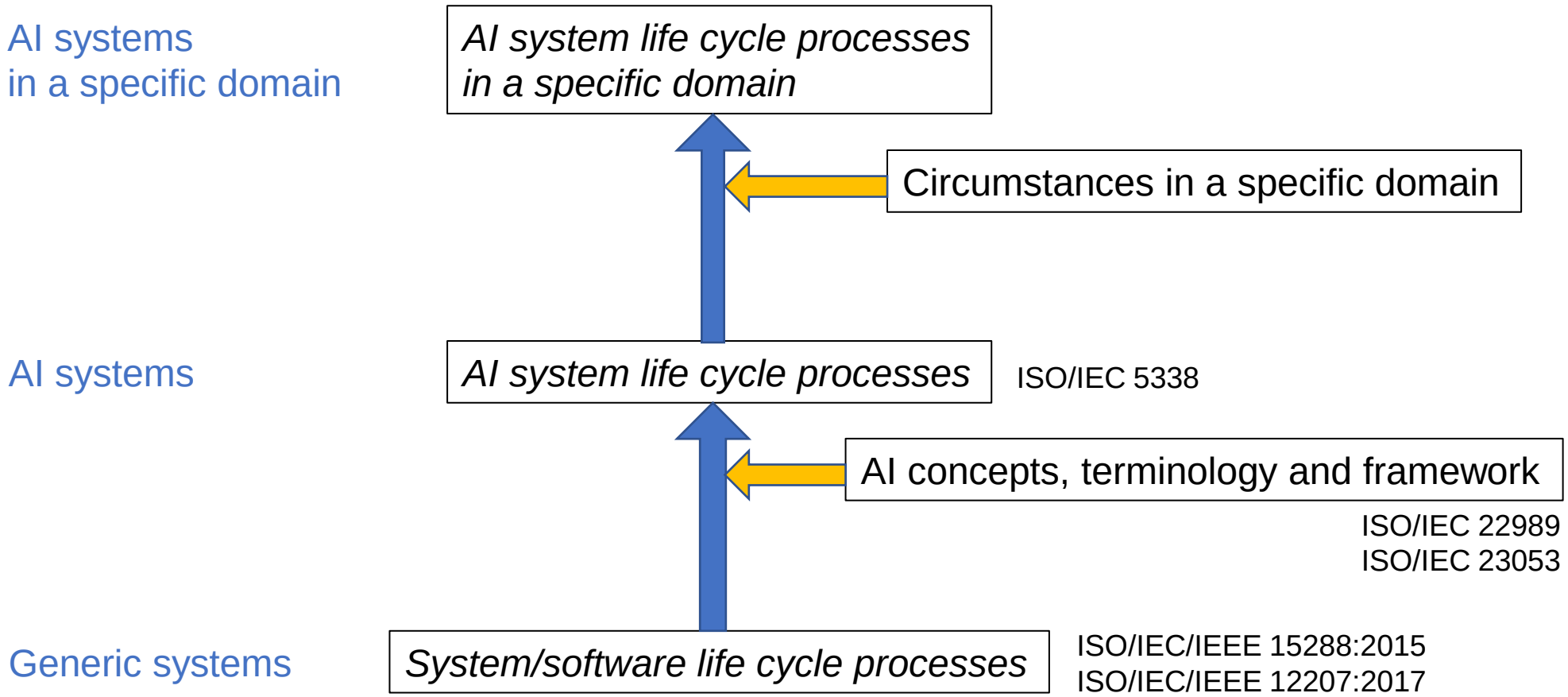
AI Characteristics	Processes	What	How
Built with the capabilities of an AI system that implements a model to acquire information and processes with or without human intervention by algorithm or programming	Training phase – algorithmic processes	Deep learning and imagification	Transforms raw data (ultrasonic testing scanning data) into image data using RGB
Applies optimizations or inferences made with the model to augment decisions, predictions or recommendations in a timely manner	AI application (Fujitsu F|AIR platform) – execution phase	Detect defects	Inspecting non-destructive ultrasonic testing scanning data
	Decision-making	Quality control or inspection decision-making	Decision-making is done through human-machine teaming. The AI system can detect defects with high coverage (more than 95%) of various defects. Humans are only expected to examine the regions of the blade that are flagged by the AI system. For example, detecting missing back wall echo, foreign object of dry glass defect, wrinkle.
Updated and improvements made to the model, system or application by evaluation of interaction outcomes	Continuous validation	Deep learning and imagification	Outcomes are monitored until certain period of time has passed since the last training or retraining or a new production process is introduced.

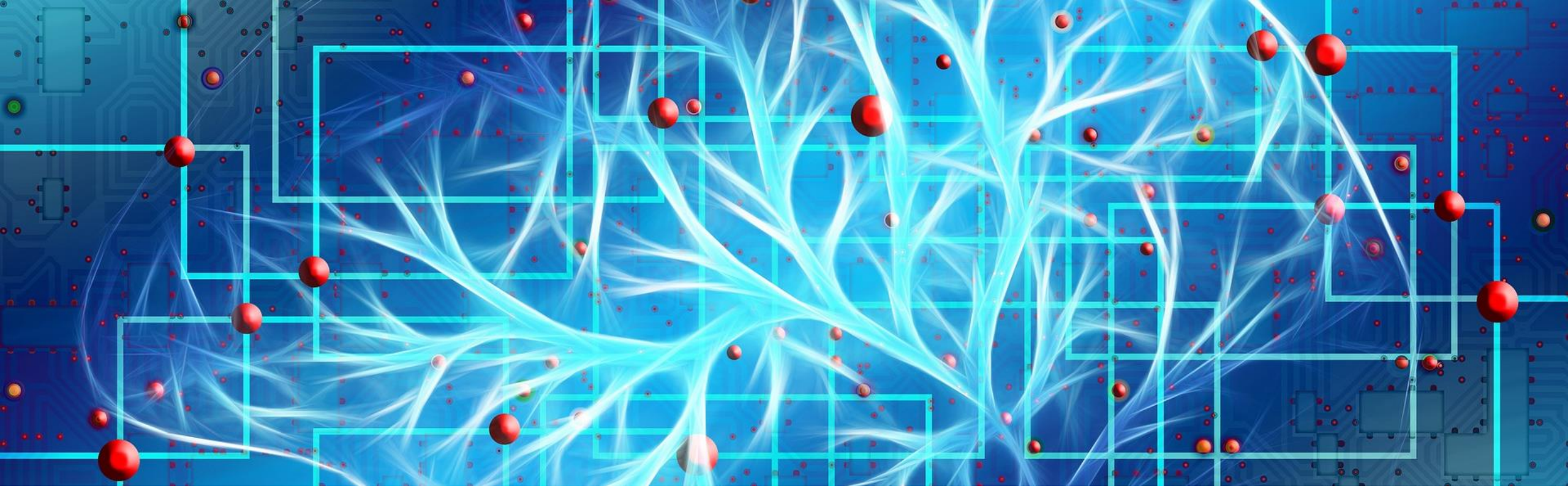
ISO/IEC CD 5338 – AI system life cycle processes

- Defines a set of processes and associated concepts for describing the life cycle of AI systems based on machine learning and heuristic systems.
- Is based on ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017 with modifications and additions of AI-specific processes from ISO/IEC 22989 and ISO/IEC 23053.

ISO/IEC/IEEE 15288:2015: Systems and software engineering — System life cycle processes
ISO/IEC/IEEE 12207:2017: Systems and software engineering — Software life cycle processes
ISO/IEC 22989: Information technology — Artificial intelligence — Artificial intelligence concepts and terminology
ISO/IEC 23053: Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)

Life cycle processes for AI systems in a specific domain





Summary

AI use cases, guidelines for AI applications and AI system life cycle processes are useful tools for collaboration among all stakeholders.

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Thank you

Fumihiro Maruyama

maruyama.f@aist.go.jp

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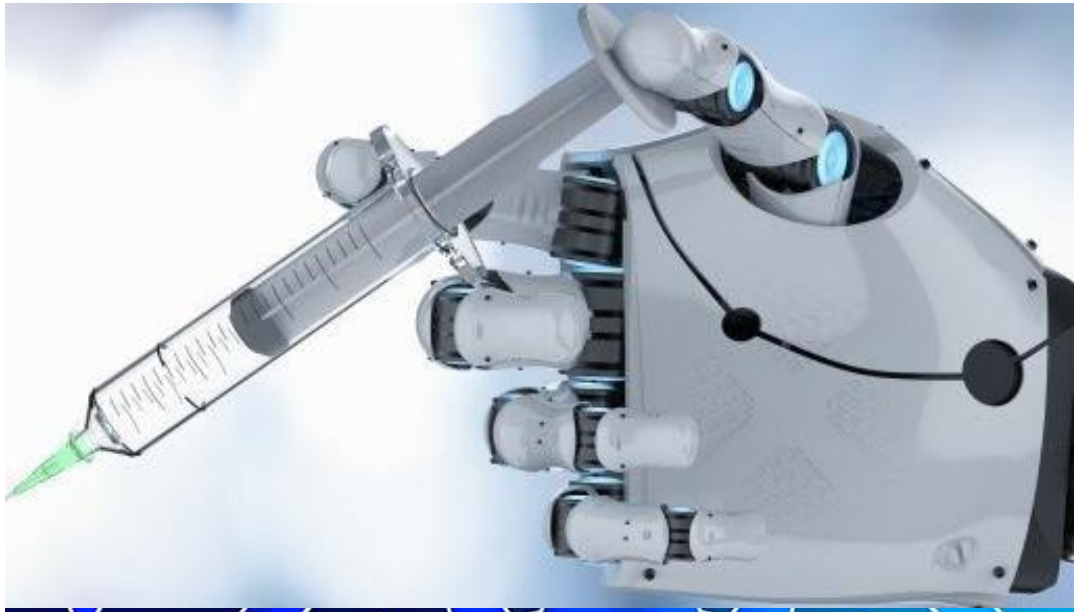

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