
IAEA Technical Meeting EVT2300917 on
Deployment of Artificial Intelligence Solutions for the Nuclear Power Industry:
Considerations and Guidance 18-21 March 2024
U.S. Nuclear Regulatory Commission Headquarters, Rockville, MD, USA

Some issues in the Assurability of safety-critical digital systems Part 1 — Assurance and AI

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The views expressed herein are those of the author and do not represent an official position of the U.S. NRC.

Assurance

- A claim (about **X**) is supported by sound, valid evidence (under the assumptions and conditions identified in **Y**).
- **X** could be a system design or an O&M process.
- **Y** is a set of conditions and assumptions under which the claim holds.
- Assurance is sometimes referenced to a CAE triplet (claim, arguments, evidence)

Artificial Intelligence

A machine-based system that can go beyond defined results and scenarios and has the **ability to emulate human-like** perception, cognition, planning, learning, communication, or physical action (NRC AI Strategic Plan).

Note: Each human-like capability is referenced to some (domain-specific) application.

AI & Assurance

- How can AI be assured?
- How can AI be used for assurance?

Assuring AI

- What are the bounds of application?
 - In nuclear: safety or non-safety, design or O&M?
- Is assurance comparable between humans and AI?
- How will the CAE needed to assure an application differ for AI?
 - Ex) Can non-interference with a safety function be assured?

AI for Assurance

- Can AI facilitate the CAE needed for assurance?
 - Data collection, processing, and analysis to support Evidence generation
 - System modelling to support Argument construction and validation
 - System and domain analysis to ensure a necessary and sufficient set of Claims to support assurance.

Assuring AI for Nuclear Cybersecurity Applications

- Ongoing NRC research exploring the use of AI to characterize nuclear cybersecurity states.
- Issues encountered relevant to assurance of cybersecurity classification models:
 - Data artifacts & joint IT/OT data
 - Model performance measures & coverage of plant states
- Answers can be very application dependent

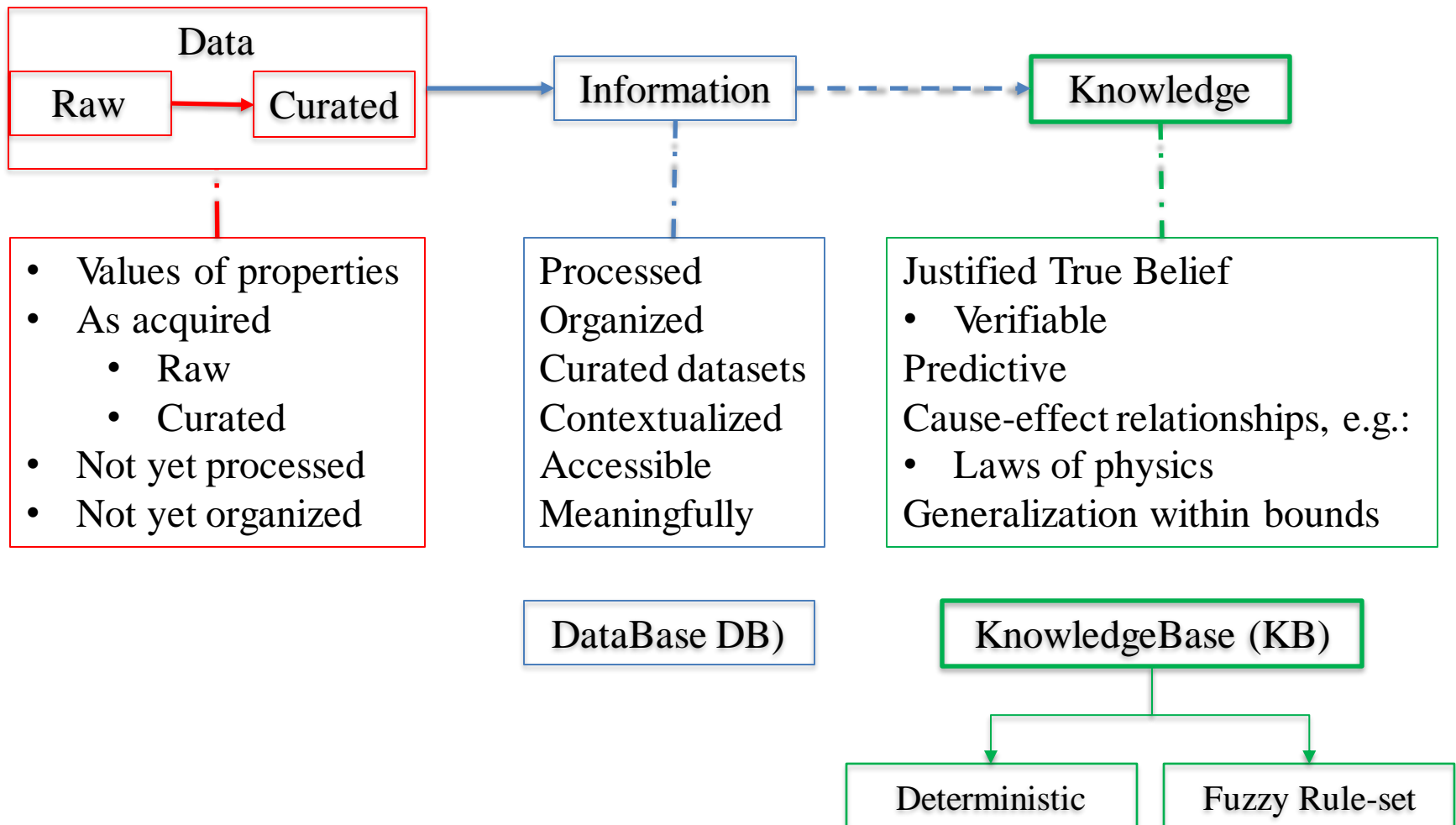
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Some issues in the Assurability of safety-critical digital systems Part 2 — Knowledge Engineering is on the back burner

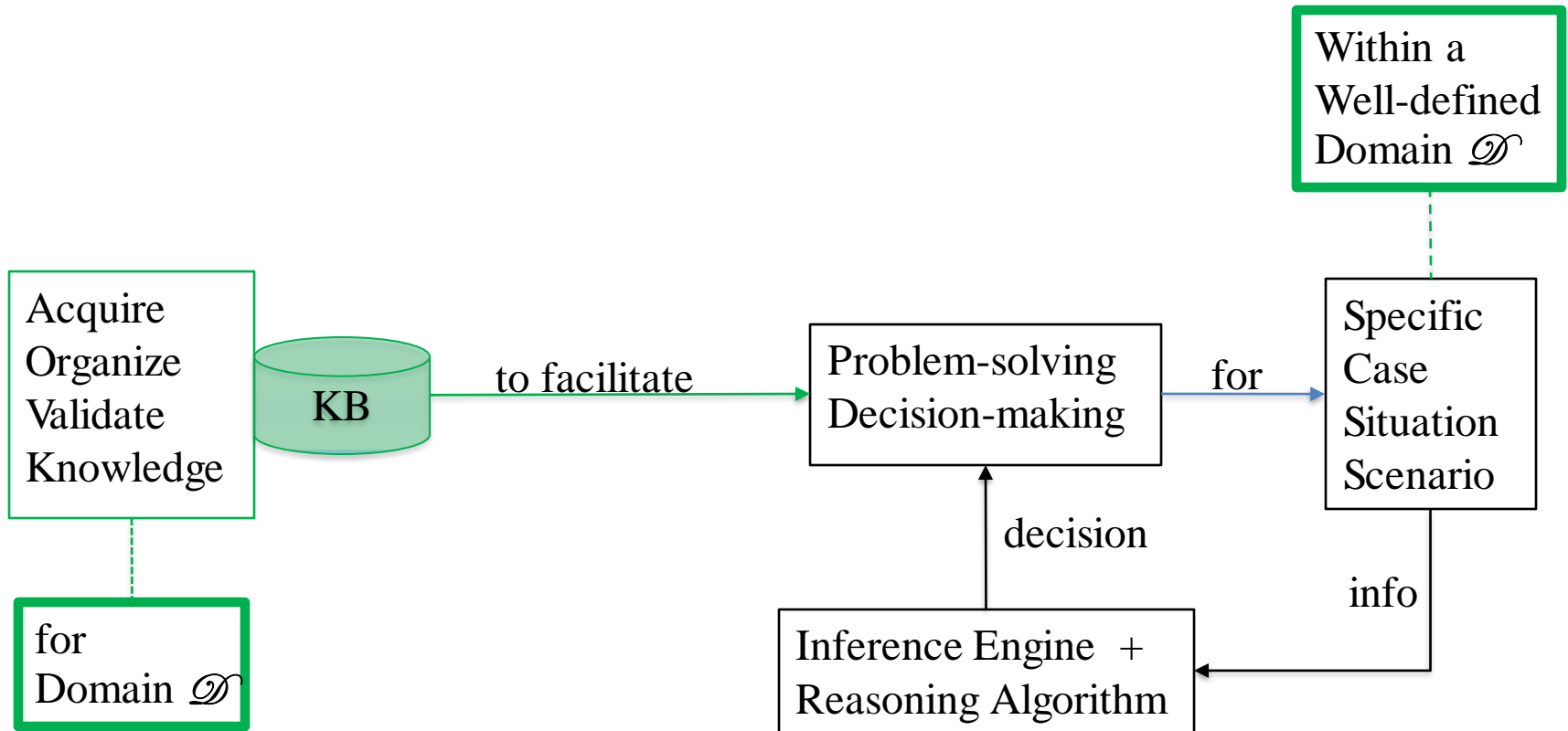
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Distinguish between data, information & knowledge



Knowledge Engineering (KE)



Knowledge Representation (KR)

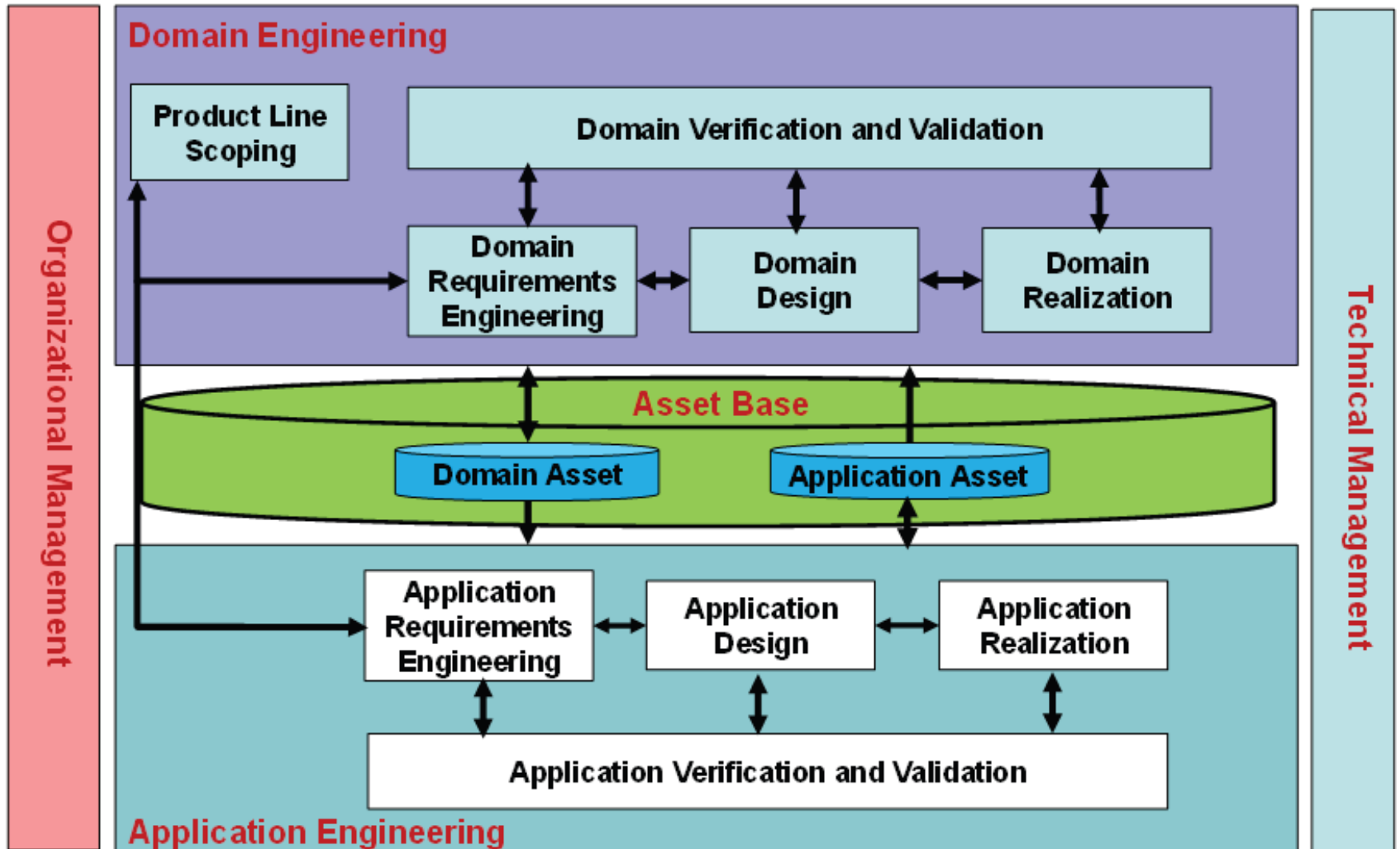
KR: the field of [artificial intelligence](#) (AI) dedicated to representing knowledge about the world in a form that can be mechanized to solve complex tasks.

Means of KR — example: Ontology

a set of concepts and categories in a subject area or domain that shows their properties and the relations between them

KR formalisms – characteristics of interest:

- Expressivity
- Tractability
- Comprehensibility
- Usability; Learnability



ISO/IEC 26550:2015(E)

Software and systems engineering — Reference model for product line engineering and management

ISO/IEC 26551:2016(E)

Tools and methods for product line requirements engineering

ISO/IEC 26552:2019(E)

Tools and methods for product line architecture design

ISO/IEC 26553:2018(E)

Processes and capabilities of methods and tools for domain realization and application realization

ISO/IEC 26554:2018(E)

Methods and tools for domain testing and application testing

ISO/IEC 26555:2015

Tools and methods for technical management

ISO/IEC 26556:2018(E)

Tools and methods for organizational management

ISO/IEC 26557:2016(E)

Methods and tools for variability mechanisms

ISO/IEC 26558:2017(E)

Methods and tools for variability modeling

ISO/IEC 26559:2017(E)

Methods and tools for variability traceability

ISO/IEC 26560:2019(E)

Methods and tools for product management

ISO/IEC 26561:2019(E)

Methods and tools for technical probe

ISO/IEC 26562:2019(E)

Processes and capabilities of methods and tools for transition management

ISO/IEC 26563:2022(E)

Processes and capabilities of methods and tools for configuration management of assets

ISO/IEC 26564: 2022(E)

Methods and tools for product line measurement

ISO/IEC 26850:2021(E)

Methods and tools for the feature-based approach to software and systems product line engineering

ISO/IEC 26565 to ISO/IEC 26599: To be developed