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# Knowledge engineering reference architecture in the context of artificial intelligence


中国电子技术标准化研究院
China Electronics Standardization Institute

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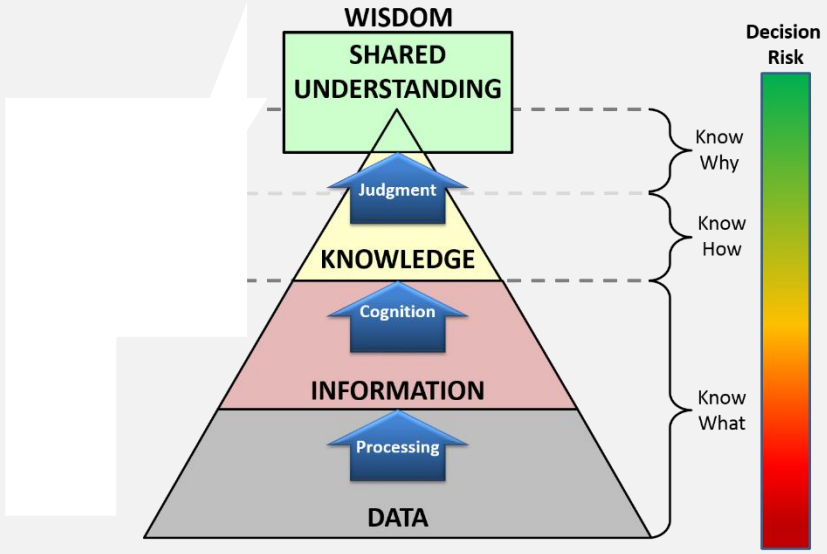
Editor of ISO/IEC 5392 Information Technology - Artificial Intelligence - Knowledge Engineering Reference Architecture

# 1. Background







**Knowledge engineering** refers to discipline concerned with acquiring knowledge from domain experts and other knowledge sources and incorporating it into a knowledge base

Note 1 to entry: The term "knowledge engineering" sometimes refers particularly to the art of designing, building, and maintaining knowledge-based systems.

[SOURCE: adapted from ISO/IEC 2382:2015, 28.01.07; remove notes]

**Artificial intelligence:** <system> capability to acquire, process, create and apply knowledge, held in the form of a model, to conduct one or more given tasks

[SOURCE:ISO/IEC TR 24030:2021(en), 3.1]

# 1. Background



Knowledge-Driven

| | | | | |
|---|---|---|---|---|
| KNOWLEDGE ENGINEERING (PROCESS TO UNDERSTAND AND REPRESENT HUMAN KNOWLEDGE) | ROBOTICS AUTOMATING (PHYSICAL REPRESENTATION OF AI, ALLOWING IT TO INTERACT WITH PHYSICAL WORLD) | SPEECH RECOGNITION (CONVERTS SPEECH TO TEXT TO ALLOW AI TO PARTICIPATE IN THE PHYSICAL WORLD) | NATURAL LANGUAGE PROCESSING (UNDERSTAND THE MEANING OF WORDS IN TEXT) | NATURAL LANGUAGE GENERATION (EXPRESS STORED INFORMATION IN AN UNDERSTANDABLE WAY) |
| IMAGE ANALYSIS (IDENTIFIES AND UNDERSTANDS WHAT CAN BE SEEN IN IMAGES AND VIDEO) | MACHINE LEARNING (LEARNING FROM DATA AND MAKING DECISIONS WITH LIMITED HUMAN INTERVENTION) | DEEP LEARNING (A BRANCH OF MACHINE LEARNING FOCUSING ON ARTIFICIAL NEURAL NETWORKS OR CREATION OF A ARTIFICIAL BRAIN) | SENSORY PERCEPTION (CONVERTS PHYSICAL CHARACTERISTICS (VIA SENSORS) TO PREDICT OUTCOMES) | COGNITION (APPLICATIONS THAT HAVE A MIND OF THEIR OWN AND CAN ACT, LEARN, INTERACT BY THEMSELVES) |

Data-Driven

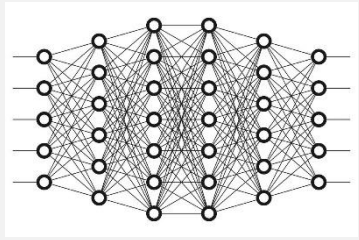
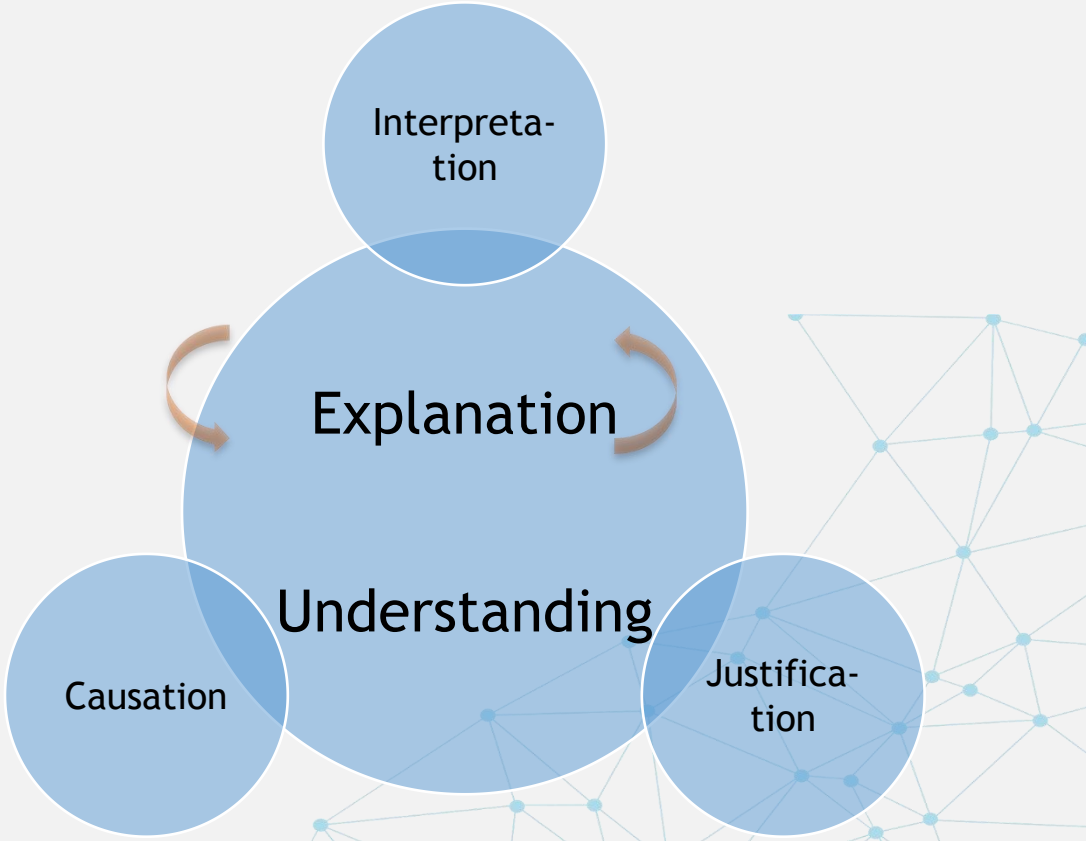


Fig.1 AI building blocks

*source:*
*https://study.com/academy/lesson/knowledge-engineering-in-ai-definition-process-examples.html*



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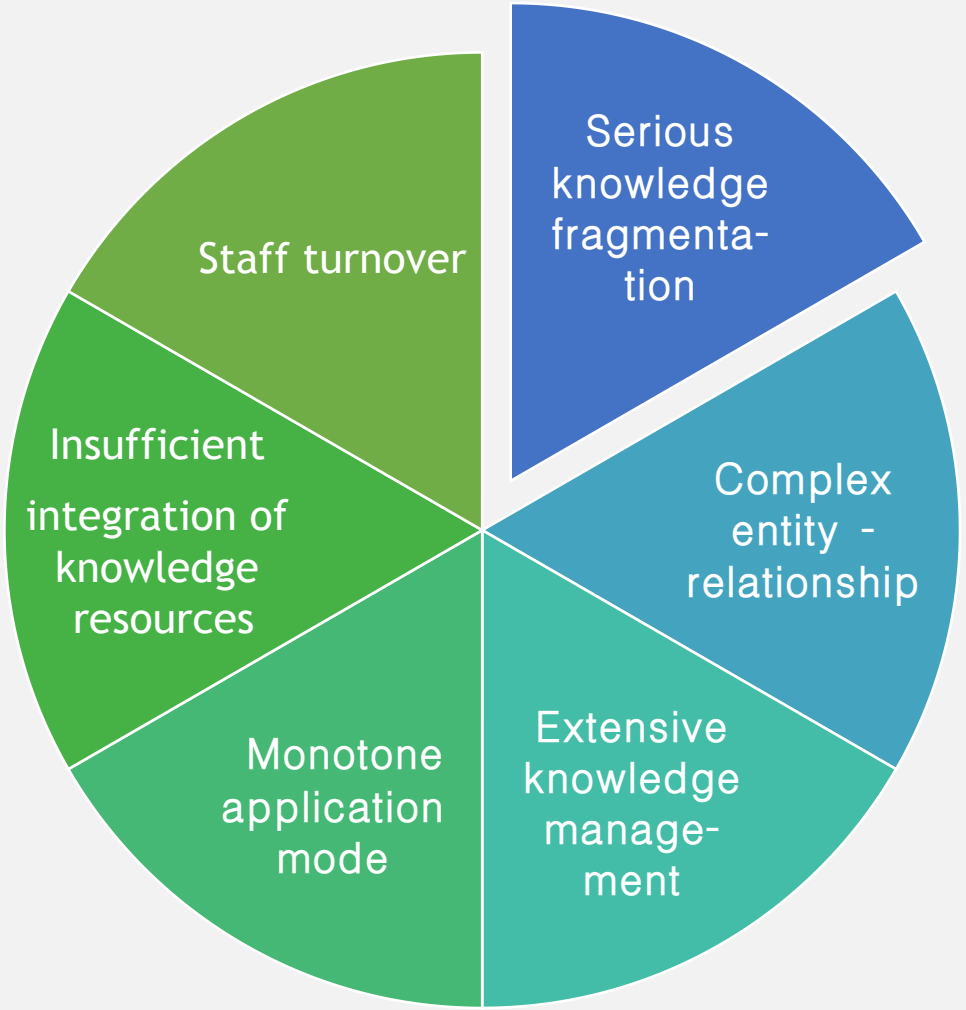


Urgent demand of

knowledge mining and efficient application

- Digital economy
- Resource optimization
- Scientific research
- Business transformation
- Public health

# 1. Background



- Financial fraud identification
- Remote operation and maintenance of equipment
- User profile and product recommendation
- Research focus tracking and forecasting
- Smart credit analysis
- Legal dispute and case prediction based on similar cases
- Intelligent distribution of news
- Intelligent computer-aided diagnosis and treatment
- Etc.

# 1. Background



Smart Finance

Smart Healthcare

Smart Manufacturing

Smart Education

Smart Power grids

Smart Transportation


Retail

Smart Agriculture

Social networks

Smart City

# 2. Content of ISO/IEC 5392

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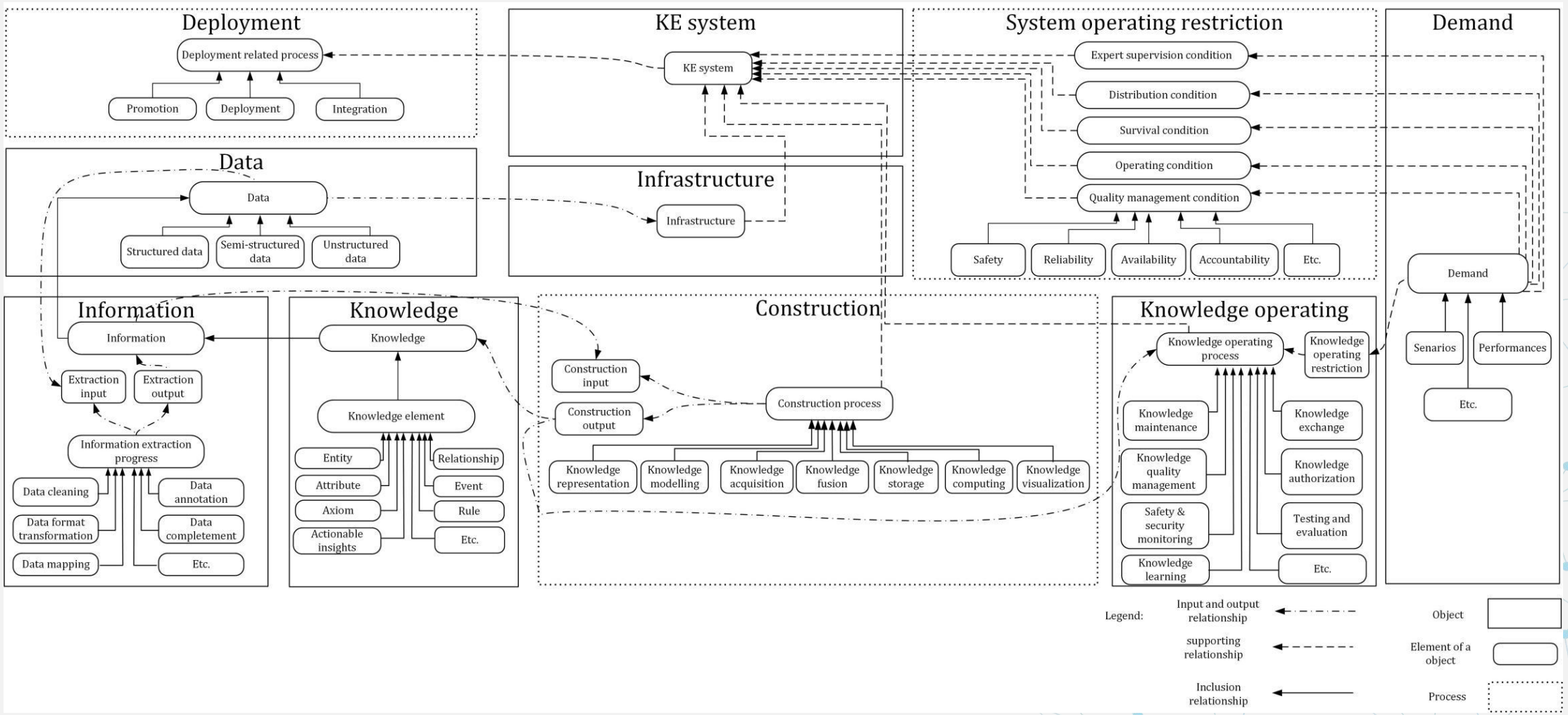
## Important elements of knowledge engineering



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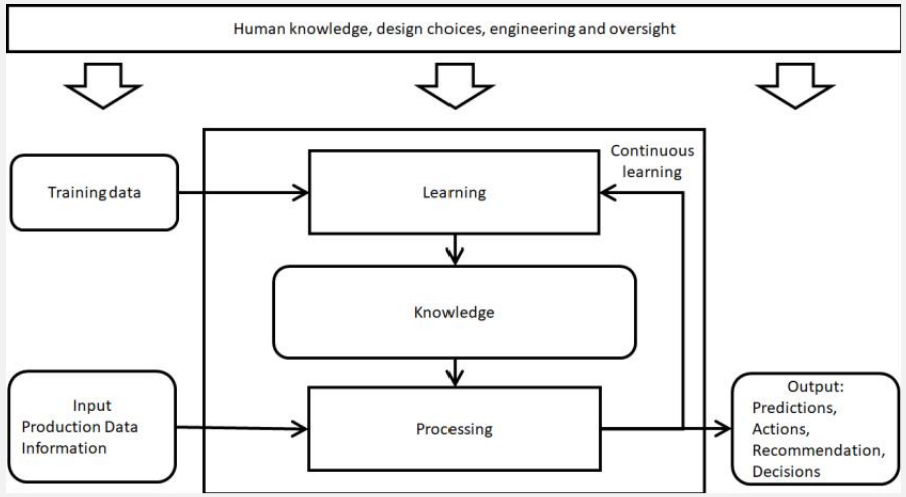
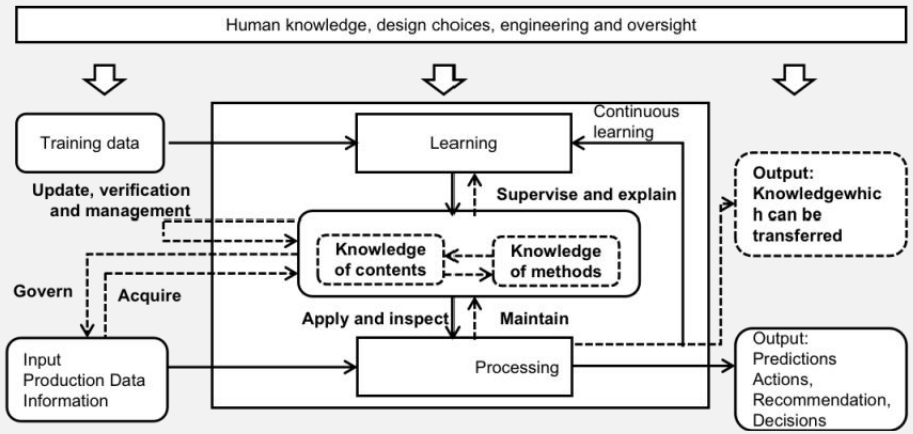



AI system functional view




AI system with KE functional view

Legend: Impact of knowledge engineering ----->

## Relationship between KE and AI systems

| Elements of AI system | | | AI system | KE impact |
|---|---|---|---|---|
| Building blocking AI system | Learning (optional) | | X | |
| | Knowledge | | X | |
| | Part of Knowledge | Knowledge of content | | X |
| | Part of knowledge | Knowledge of methods | | X |
| | Processing | | X | |
| Interaction with AI system | Human knowledge, design choices, engineering and oversight | | X | |
| | Training data (optional) | | X | |
| | Input (production data, information) | | X | |
| | Output (prediction, actions) | | X | |
| | Output (knowledge which can be transferred, actionable insights) | | | X |

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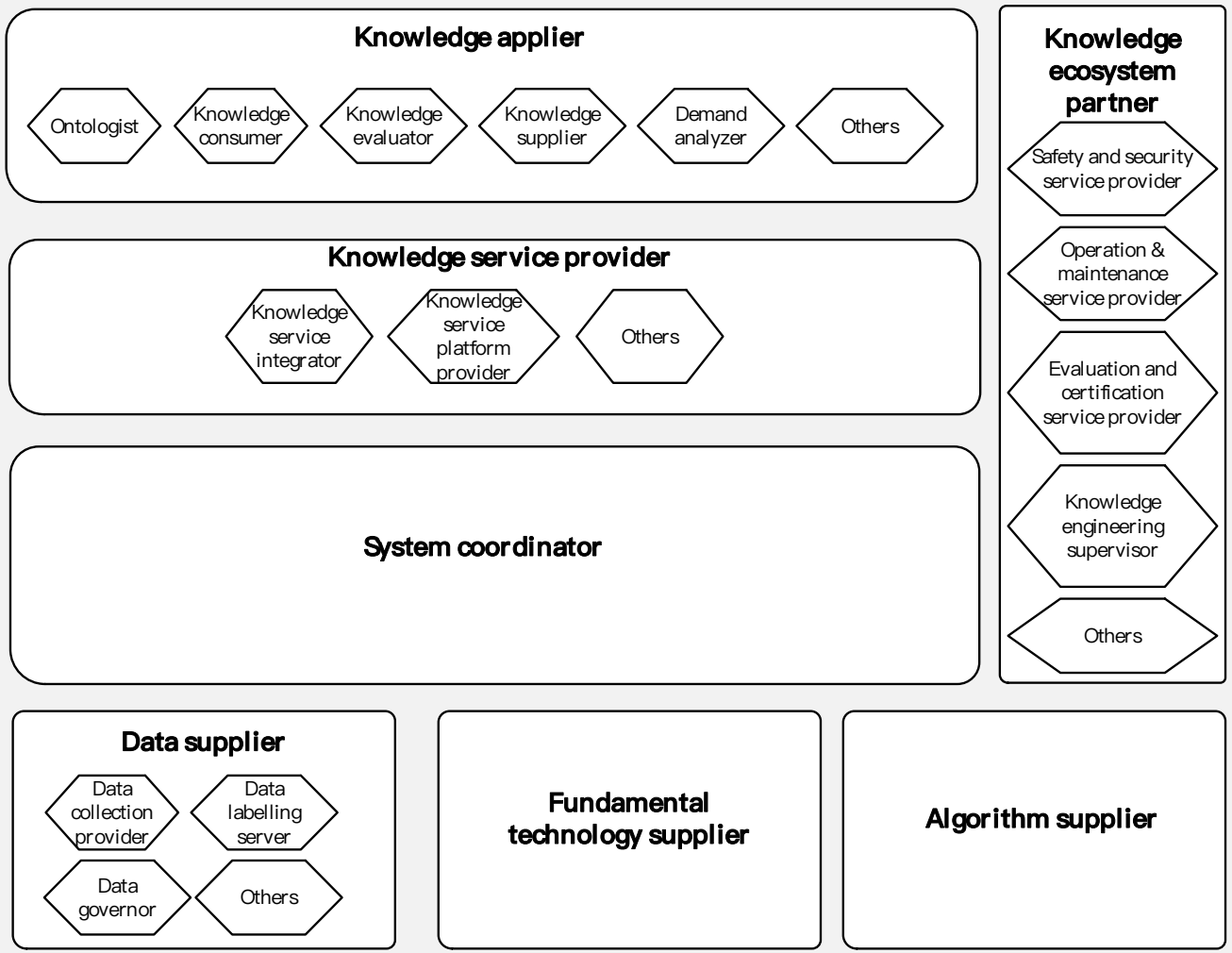
## KE stakeholders




## Concerns of KE stakeholders

- **Safety and security**
- **Reliability**
- **Availability**
- **Construction quality**
- **Responsibility**
- **Bias reduction**

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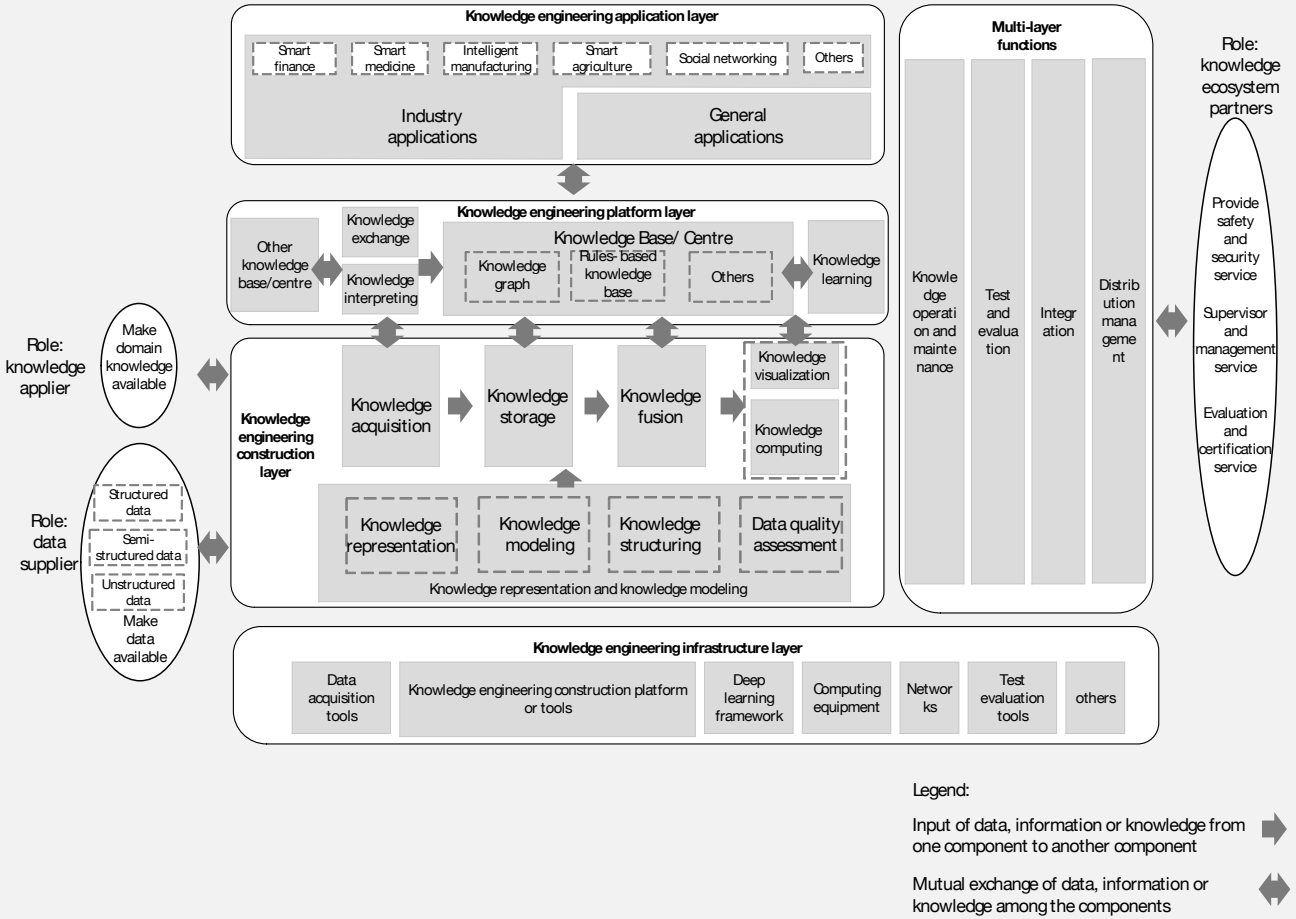
## Reference architecture of KE




| AI system with KE functional view | Functional architecture of KE | |
|---|---|---|
| | Layer | Component |
| Acquiring of knowledge | KE construction layer | Knowledge representation |
| | | Knowledge modelling |
| | | Knowledge structuring |
| | | Knowledge acquisition |
| | | Detection and reporting of knowledge conflicts |
| | | Knowledge storage |
| | | Knowledge fusion |
| Knowledge base | KE platform layer | Knowledge base or centre |
| Continuous learning | KE platform layer | Knowledge learning |
| Updating, verification and management of knowledge | Multi–layer functions | Test and evaluation |
| | KE construction layer | Knowledge computing |
| | | Knowledge visualization |
| Supervise and explain of learning process and results | KE application layer | Industry applications |
| | | General applications |
| Applyand inspectionof knowledge in data and information processing | KE infrastructure layer | Deep learning framework |
| | KE application layer | Industry applications |
| | | General applications |
| Maintenance of knowledge | Multi–layer functions | Knowledge operation and maintenance |
| | | Distribution management |
| Governance of data and information | KE construction layer | Knowledge representation |
| | | Knowledge structuring |
| | | Data quality assessment |
| | KE platform layer | Knowledge interpreting |
| Output of knowledge which can be transferred and actionable insights | KE platform layer | Knowledge exchange |
| Outputof predictionsand actions | KE application layer | Industry applications |
| | | General applications |

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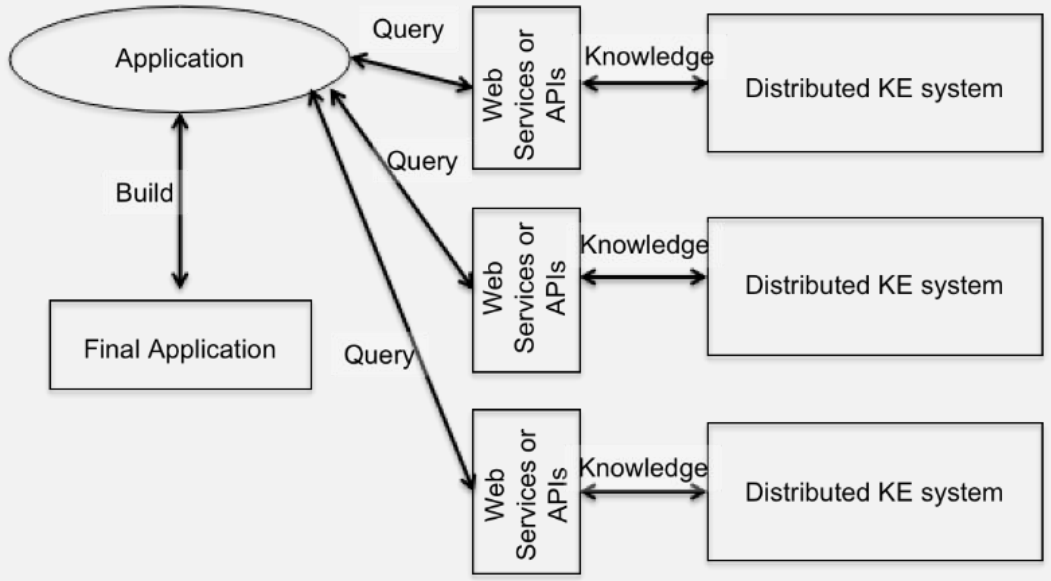
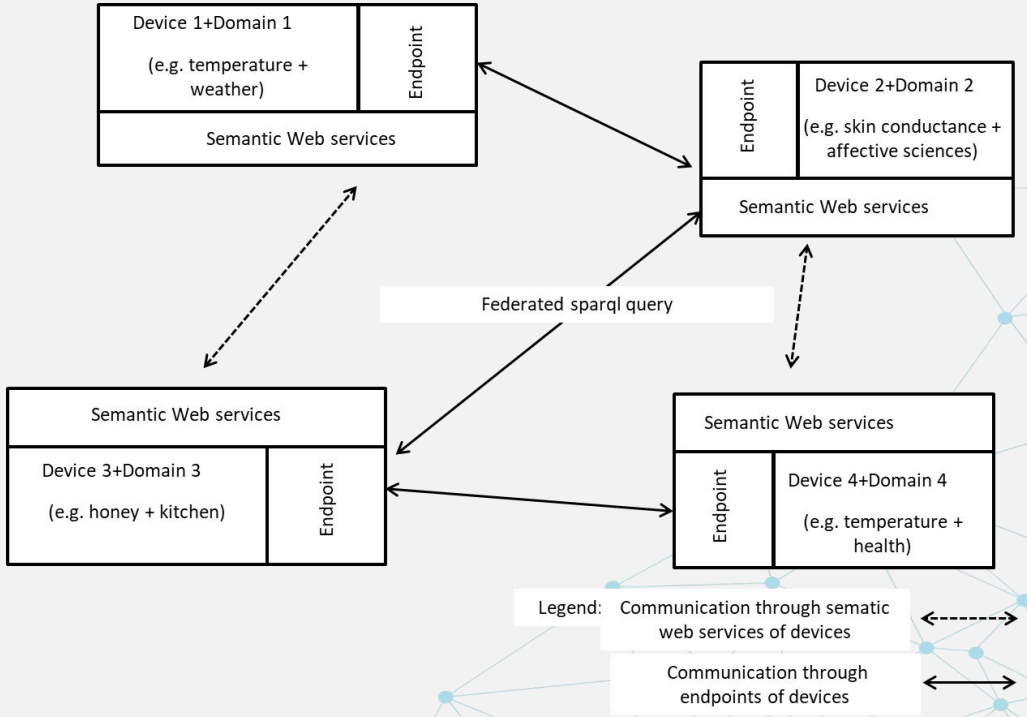
## KE distribution architecture



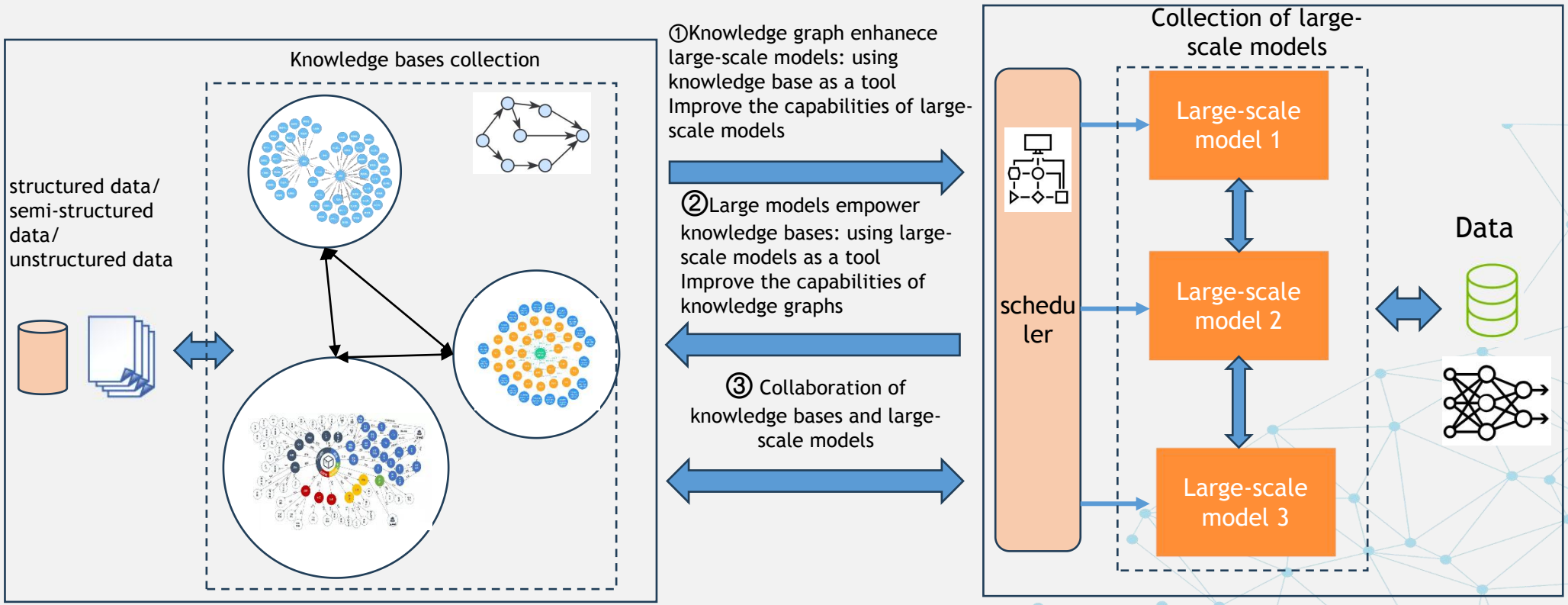

## Querying distributed RDF data applied to internet of things



# 3. Development and standardization demands of knowledge engineering in the context of AI



## integration among large-scale pretrained model and knowledge bases



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# Thank you!

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