Knowledge Graphs and Industry 4.0

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Key Concepts

Industry 4.0

Smart Factories
CPS
IIOT
AI

Interoperability

Ability to share information between systems in meaningful ways

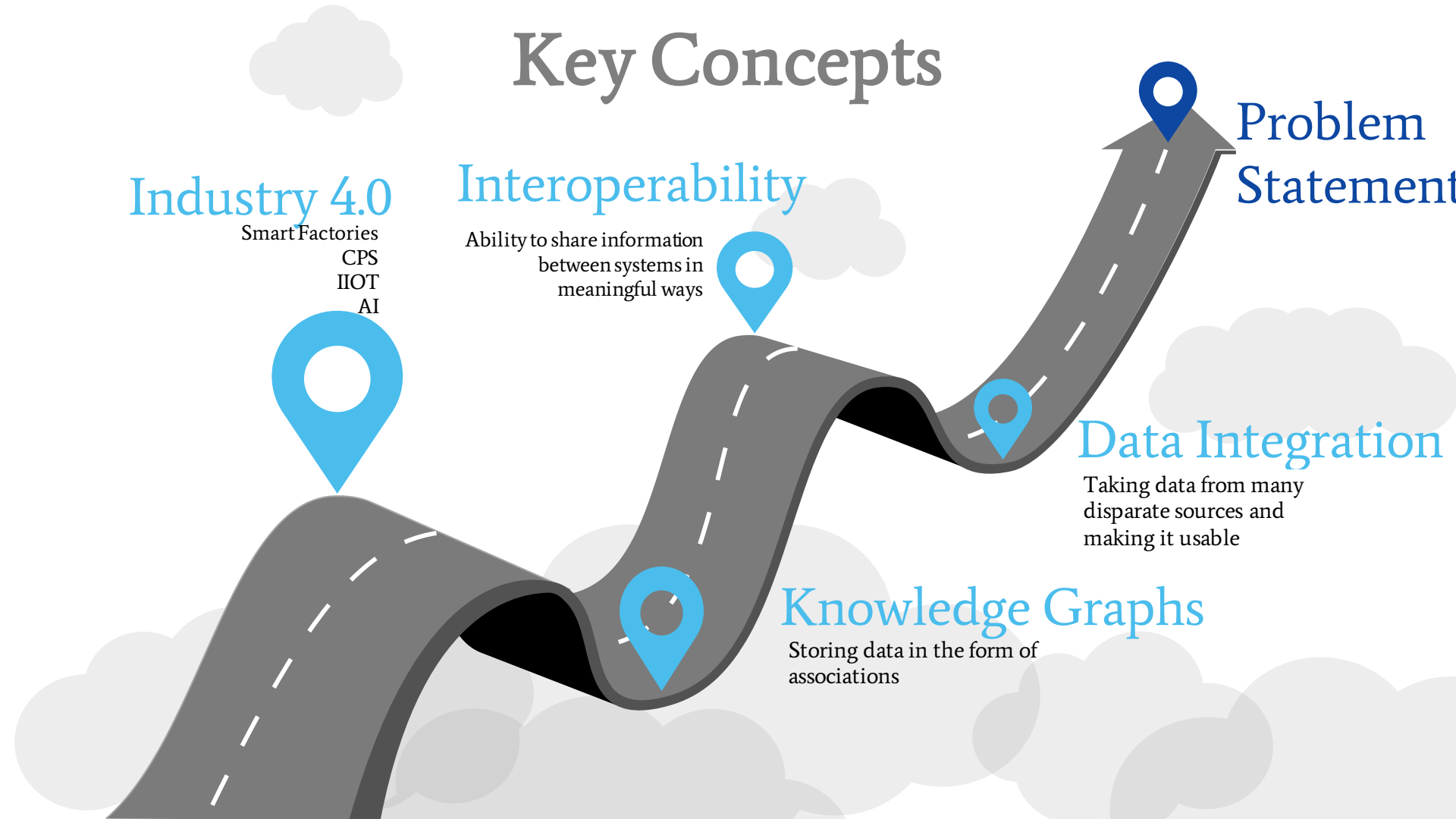
Problem Statement

Data Integration

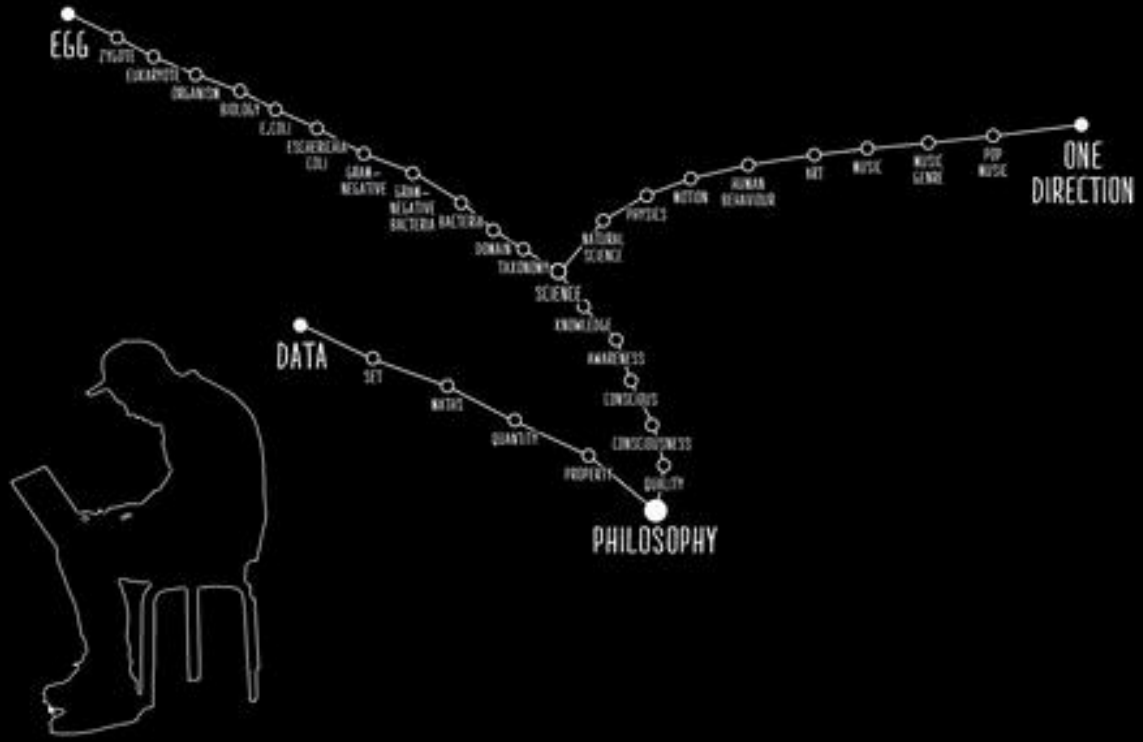
Taking data from many disparate sources and making it usable

Knowledge Graphs

Storing data in the form of associations

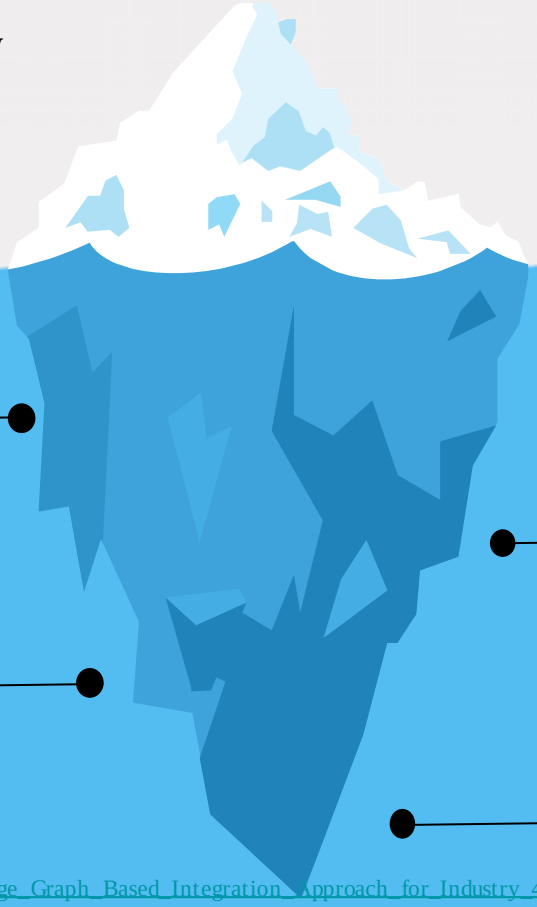


Connecting Data with Knowledge Graphs[1]



HOW DO KNOWLEDGE GRAPHS HELP IN SOLVING INTEROPERABILITY CONFLICTS

- The fourth industrial revolution, Industry 4.0 (I40) aims at creating smart factories CPS, IoT and AI.
- Smart factories I40 vision: intelligent human-to-machine, machine-to-machine communication.



- Different standards may contain divergent definitions for similar entities.
- For establishing interoperability, industry communities have created standards and standardization frameworks.

INTEROPERABILITY CONFLICTS

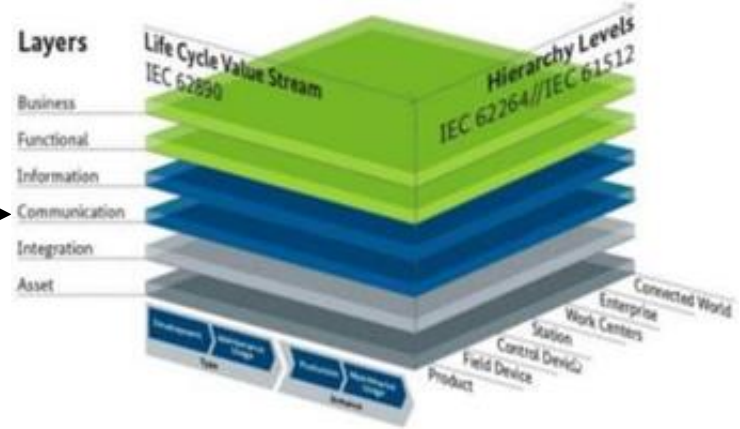
FIRST LEVEL OF CHALLENGES

METHODOLOGY FOR CREATING I40KG

STO ONTOLOGY

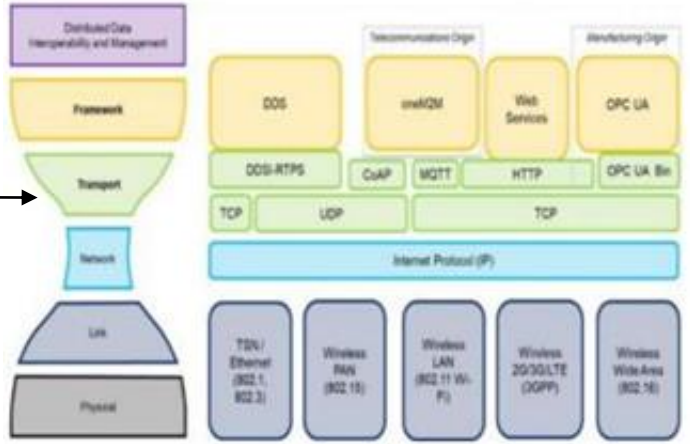
[2]https://www.researchgate.net/publication/333532727_A_Knowledge_Graph_Based_Integration_Approach_for_Industry_40

OPC UA,
MQTT



OPC UA

MQTT



INTEROPERABILITY CONFLICTS

RAMI4.0 IT layer

Reference Architectural Model for I40

Both, OPC UA and MQTT positioned at communication level, stating that both standards are similar.

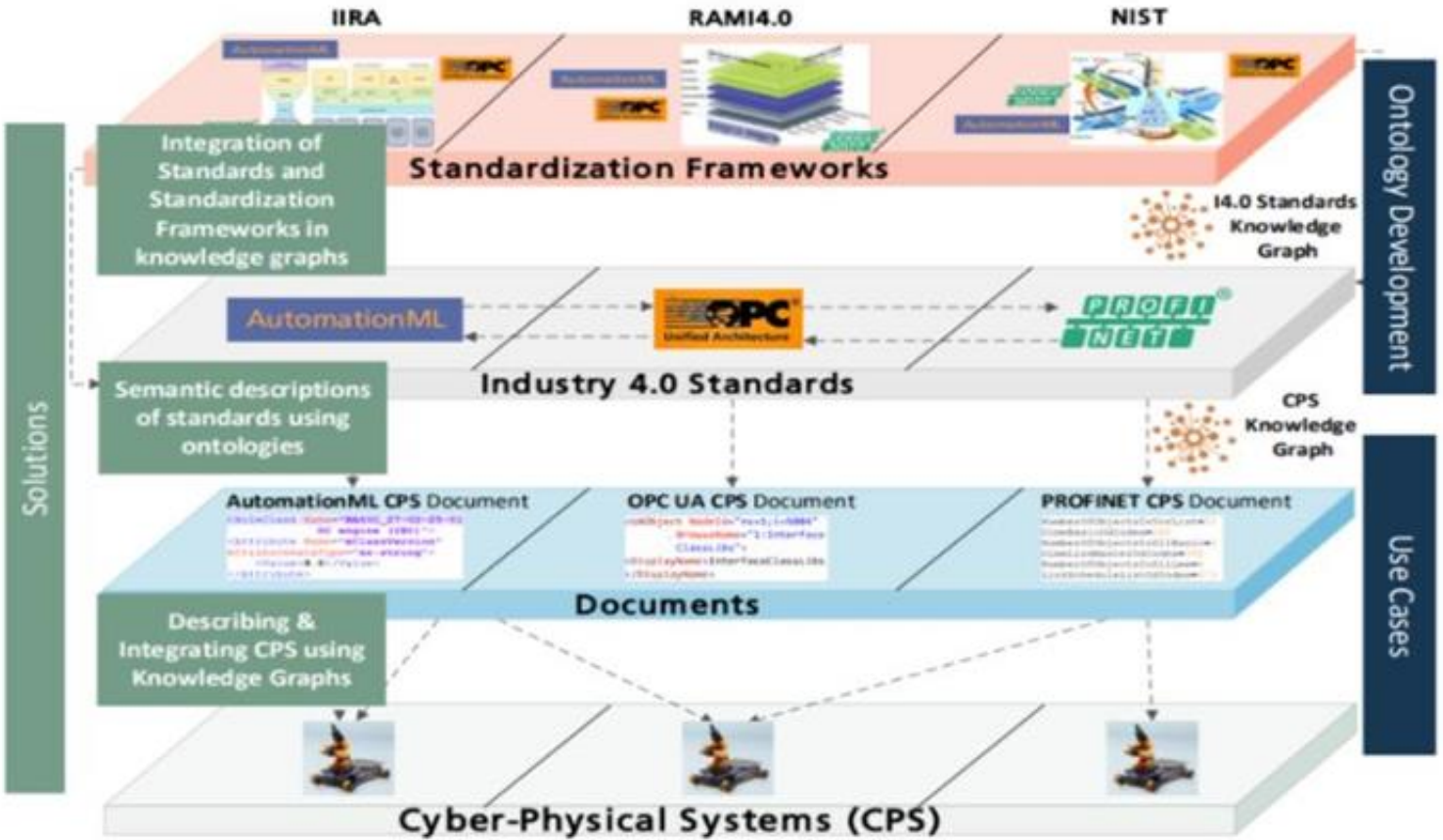
IICF Model

Industrial Internet Connectivity Framework

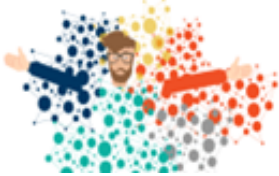
OPC UA and MQTT at distinct layers, i.e., the framework and the transport layers, respectively

[3]https://link.springer.com/chapter/10.1007%2F978-3-030-59051-2_12

FIRST LEVEL OF CHALLENGES[21]



METHODOLOGY FOR CREATING I40KG[2]



Generic Ontology?
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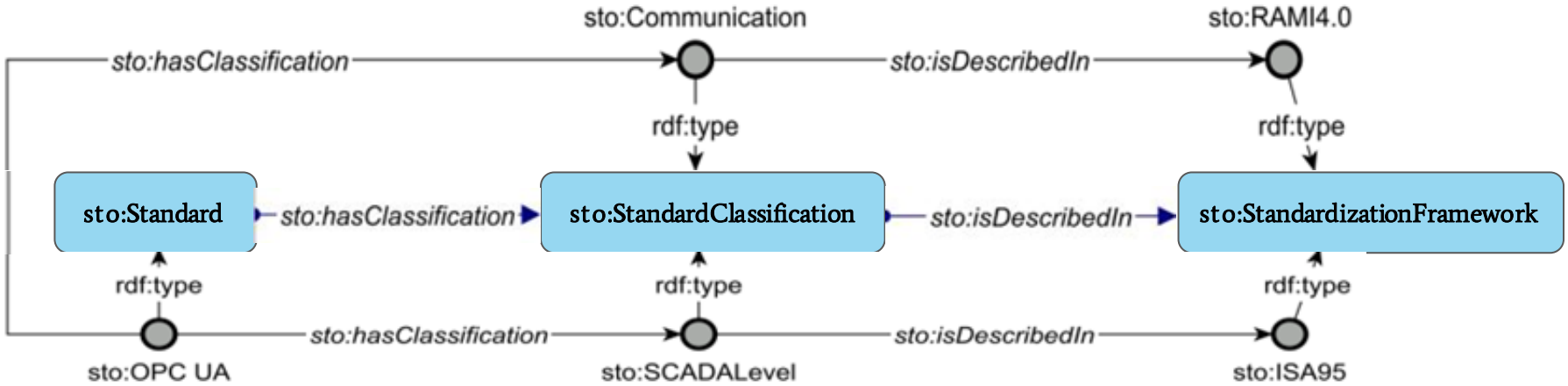
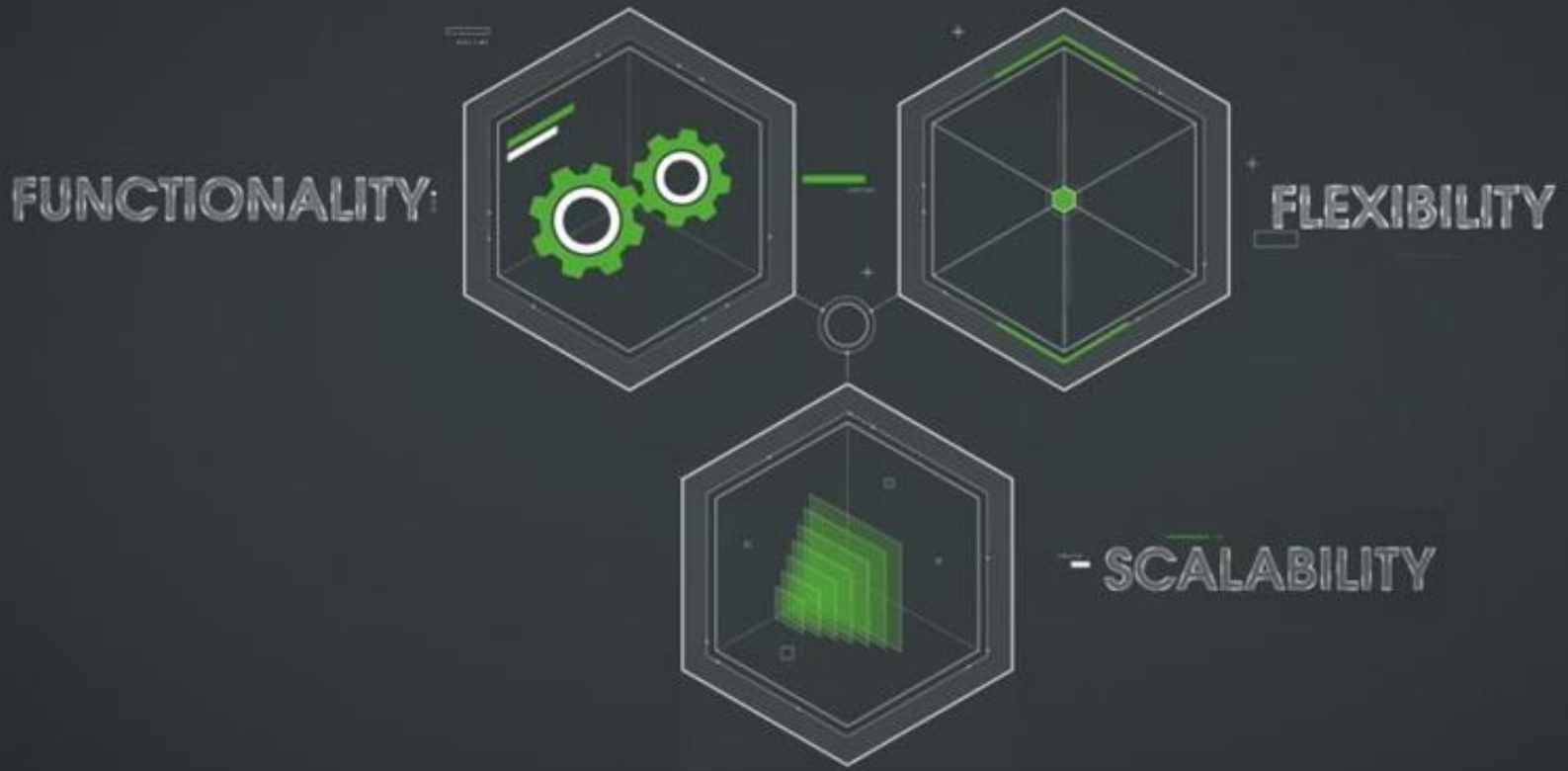
STO

Legend
- Manual
- Semi-automatic

THE STANDARDS ONTOLOGY[2]



PTC ThingWorx



[4]https://www.ptc.com/en/products/thingworx

DECISION LABEL:
direct operation grouping and behavior decision of equipment operation and maintenance

MODEL LABEL:
marking after secondary processing based on the grid equipment analysis model, equipment status

FACT LABEL: categorization based on raw data cleanup, alarm times, failures times, power outages times

RAW DATA: equipment ledger, measurement data, maintenance data, event data and operation data obtained through the data center

[5]https://www.hindawi.com/journals/mpe/2020/8269082/