



The Standards People

IoT Conference 2023

ISO/IEC JTC1/SC41 Digital Twins Activities

SESSION 9: Digital Twin: The Key to Digital Transformation

Presented by: Antonio Kung



July 5th, 2023



Speaker



CEO Trialog – IoT systems

- Smart meters
- Vehicle charging
- Connected vehicles
- Health

Involved in

- AIOTI
- BDVA

Involved in

- ISO/IEC
- ISO
- ITU-T
- CEN-CENELEC

Standardisation topics

- Architecture
- IoT, Digital twin, AI
- Security and Privacy

AG8 - Meta Reference Architecture

- Best practices and guidance for reference architectures

SC27 and PC317 – Security and privacy

- 27091 AI systems - Privacy protection (WD)
- 27115 Cybersecurity evaluation of complex systems (NP)
- 27550 Privacy engineering
- 27556 Privacy preference management
- 27561 POMME – Privacy operationalisation (DIS)
- 27563 Security and privacy in AI use cases
- 27568 Security and privacy of digital twins
- 27570 Privacy guidelines for smart cities
- 31700 Privacy-by-design for consumer goods and services

SC41 - Internet of things, digital twins

- 21823-3 Semantic Interoperability
- Behavioral and policy interoperability (PWI)
- 30141 IoT reference architecture (DIS)
- 30149 IoT trustworthiness principles (DTS)
- 30188 Digital twin reference architecture
- Integration of IoT and digital twin in data spaces (PWI)

SC42 AI

- 5392 Knowledge engineering reference architecture (DIS)

TC215 Health informatics

- Application of AI Technologies in Health Informatics (Ahg2 report)

TC22 Automotive

- 21434 Road vehicle cybersecurity engineering
- 5112 Guidelines for auditing cybersecurity engineering

Global presentation of ISO/IEC JTC 1/SC 41

IoT and Digital twins

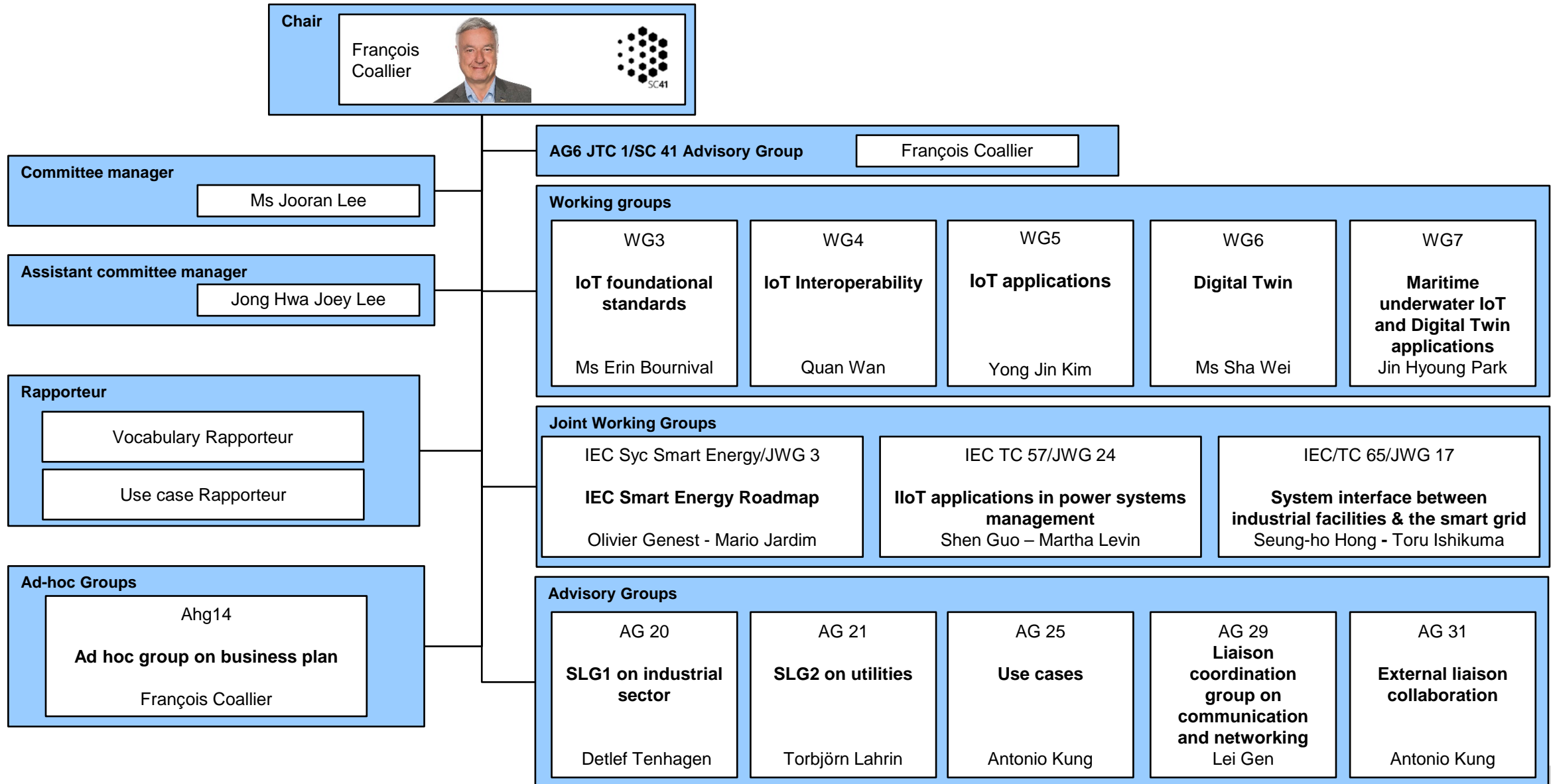


ISO/IEC JTC 1/SC 41 Internet of Things

- ▀ **History** (<https://jtc1info.org/sd-2-history/jtc1-subcommittees/sc-41/>)
 - ▀ 2009: Creation of JTC 1/WG 7: Sensor networks
 - ▀ 2014: Creation of JTC 1/WG 10: IoT
 - ▀ 2016: Creation of SC41: IoT and related technologies
 - **Merging of WG 7 and WG 10**
 - ▀ 2020: Adding Digital Twins in the scope

- ▀ **Scope** (https://www.iec.ch/dyn/www/f?p=103:7:16160045003496:::FSP_ORG_ID,FSP_LANG_ID:20486,25)
 - ▀ Standardization in the area of Internet of Things and Digital Twin, including their related technologies.
 - **Serve as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.**
 - **Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.**

ISO/IEC JTC 1/SC 41 structure



Standards lifecycle and conventions

Conventions

- Green = published
- Orange >= Committee Draft (national body level)
- Red < Committee Draft (expert level)



Type of standards

- IS: international standard
- TS: technical specification
- TR: technical report

Published Standards

(TR technical report – TS technical specification)

<p>20924 2021 IoT - Vocabulary</p>	<p>21823-1 2020 IoT interoperability - framework</p>	<p>22417 TR 2017 IoT use cases</p>	<p>29182-1 2017 SNRA General overview and requirements</p>	<p>29182-7 2015 SNRA Interoperability guidelines</p>	<p>30140-1 2018 UWASN – Overview and requirements</p>
<p>30141 2018 IoT reference architectures</p>	<p>21823-2 2020 IoT transport interoperability</p>	<p>30163 2021 SN-based integrated platform for chattel asset monitoring</p>	<p>29182-2 2013 SNRA Vocabulary and terminology</p>	<p>20005 2013 Collaborative information processing in intelligent SN</p>	<p>30140-2 2017 UWASN – Reference architecture</p>
<p>30147 2021 Integration of IoT trustworthiness in ISO/IEC/IEEE 15288</p>	<p>21823-3 2021 IoT semantic interoperability</p>	<p>30169 2022 IoT applications for electronic label systems (ELS)</p>	<p>29182-3 2014 SNRA Reference architecture views</p>	<p>30128 2014 Generic SN Application Interface</p>	<p>30140-3 2018 UWASN – Entities and interfaces</p>
<p>30164 2020 IoT Edge computing</p>	<p>21823-4 2024 IoT syntactic interoperability</p>	<p>30176 TR 2021 Integration of IoT and DLT/blockchain: use cases</p>	<p>29182-4 2013 SNRA Entity models</p>	<p>19637 2016 SN testing framework</p>	<p>30140-4 2018 UWASN – Interoperability</p>
<p>30165 2021 Real-time IoT</p>	<p>30161-1 2020 Data exchange platform for IoT - Requirements & architecture</p>	<p>30179 2023 IoT system for ecological environment monitoring</p>	<p>29182-5 2013 SNRA Interface definitions</p>	<p>22560 TR 2017 SN - Aeronautics active air-flow control</p>	<p>30142 2020 UWASN – Network mgt system overview & requirements</p>
<p>30166 TR 2020 Industrial IoT</p>	<p>30161-2 2023 Data exchange platform for IoT – Transport interoperability</p>		<p>29182-6 2014 SNRA Applications</p>	<p>30101:2014 SN and its interfaces for smart grid system</p>	<p>30142-2 2020 UWASN – Network management system u-MIB</p>
	<p>30162 2023 Compatibility requirements within industrial IoT systems</p>				<p>30143 2020 UWASN – Application profiles</p>
Foundational	Interoperability	Application	Sensor network		Underwater acoustic network

SC41 Standards under development

20924:Ed2 IoT and digital twin - Vocabulary	30173 Digital twin concepts and terminology
30141 Ed2 IoT reference architecture	30168 TS Generic Trust Anchor API for Industrial IoT Devices
30149 TS IoT trustworthiness principles	
30187 Evaluation indicator for IoT systems	PWI Digital Twin – Extraction and transactions of data components
30188 Digital twin Reference Architecture	PWI Guidance on IoT and digital twin integrations in data spaces
30186 Digital twin maturity model	
Foundational	

30178 IoT Data format, value and coding
30181 Functional architecture for resource ID interoperability
PWI 8 IoT and Digital twin Behavioral and policy interoperability
TR PWI 11 Digital twin correspondence measure of DTw twinning
Interoperability

TR Best practices for use case projects	30172 TR Digital twin use cases
30180 Status of self- quarantine through IoT data interfaces	30184 Autonomous IoT object identification in connected home
30189-1 TR IoT-based cultural heritage management – Framework	
TR PWI 13 IoT Applications for Long- distance Oil and Gas Transmission Pipeline	TR PWI 12 Environmental effect of underwater acoustic signalling
TR PWI IoT Applications for Natural Gas Distribution System	TR PWI 10 IoT-based cultural heritage management – Use cases
PWI System requirements of IoT- based fixed asset seizure management	
Applications	

30177 Underwater network mgt system (U- NMS) interworking
30183 Interoperability of UWASNs based on underwater delay & U- DTN
30185 Interoperability of UWASNs & IPV6
Underwater

ISO/IEC JTC 1/SC 41 activities on digital twins



Digital Twins Standards under Development (Yellow Dots)

20924:Ed2 IoT and digital twin - Vocabulary 1	30173 Digital twin concepts and terminology 2
30141 Ed2 IoT reference architecture	30168 TS Generic Trust Anchor API for Industrial IoT Devices
30149 TS IoT trustworthiness principles	
30187 Evaluation indicator for IoT systems	PWI Digital Twin – Extraction and transactions of data components 5
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30172 TR Digital twin use cases (under publication)

Construction

- Smart building - Smart building operation based on digital twins
- Industrial smart park - Digital twin based industrial smart park design and construction
- Smart construction lifecycle - Construction-phase digital twin model

Smart city

- Smart city - Digital twin based smart city management system
- Smart city – Greater Hobart digital twin
- Smart city – NSW spatial digital twin
- Transport – TfNSW infrastructure delivery digital twin

Water

- Smart building - Monitoring of water

Energy

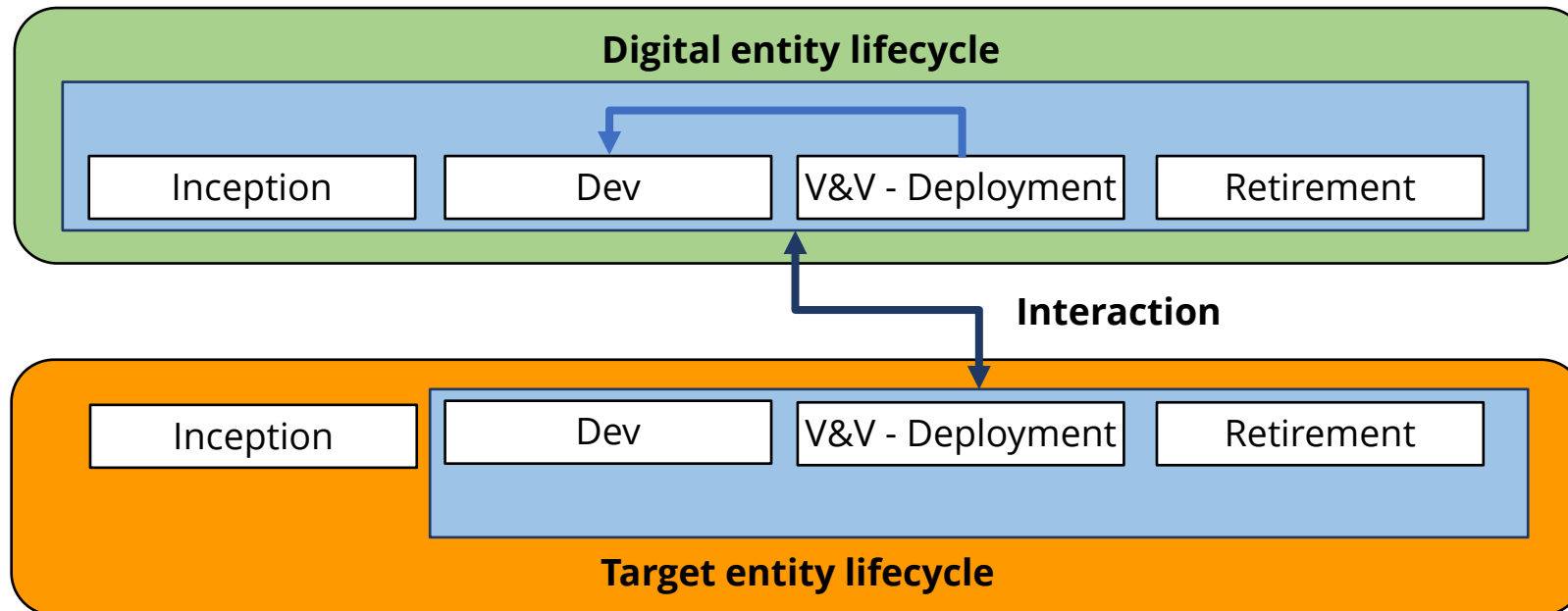
- Smart energy - Construction and application of digital twins for a large oil and gas processing facility
- Smart building - Consumer behavioural digital twin for energy demand prediction
- Smart power grid - Smart grid operation based on a digital twin
- Smart energy – From grid planning to grid operation and maintenance, based on grid digital twin(s)
- Smart energy – Electrical field level subsystem digital twin

30173 Digital twin concepts and terminology / 20924 IoT and digital twin vocabulary (publication 2023)



Definition

- digital representation of a **target entity** with data connections that enable convergence between the physical and digital states at an appropriate rate of synchronization
 - Note 1 to entry: Digital twin has **some or all** of the capabilities of connection, integration, analysis, simulation, visualization, optimization, collaboration, etc.
 - Note 2 to entry: Digital twin can provide an **integrated view throughout the life cycle** of the target entity.
 - Note 3 to entry: The target entity, which provides some functional purpose in reality, can be either **physical or digital** under consideration.



30186 Digital twin maturity model (publication end 2025)

▀ Maturity aspects

▀ Convergence

- Disconnected
- Synchronized
- Federated
- Collaborative
- Unified

▀ Capability

- Descriptive/mirroring
- Diagnostic/monitoring
- Predictive/modelling and simulation
- Optimized/prescriptive
- Autonomous

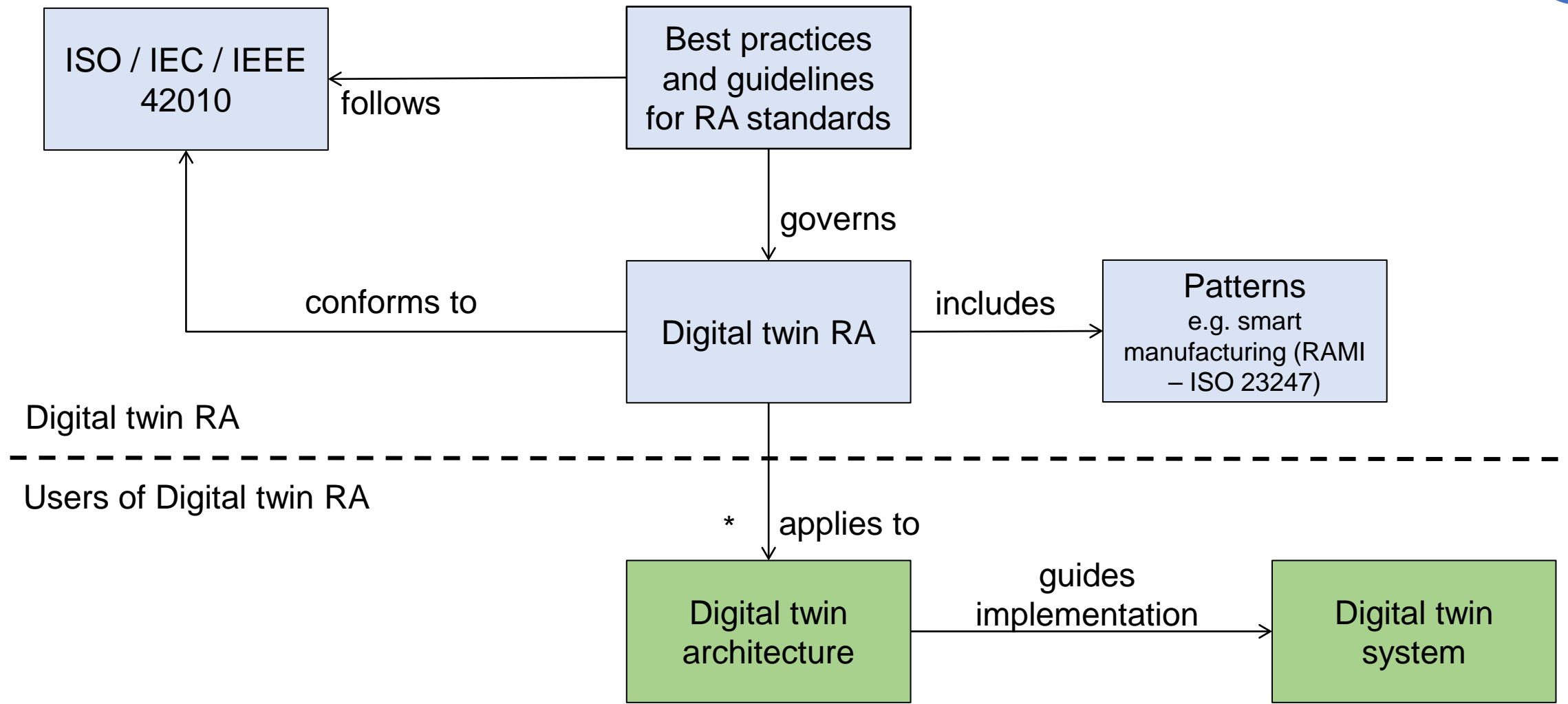
▀ Integration

- Task specific
- Connected
- System views
- System of system/value chain augmented views
- Enterprise/supply chain supervising view

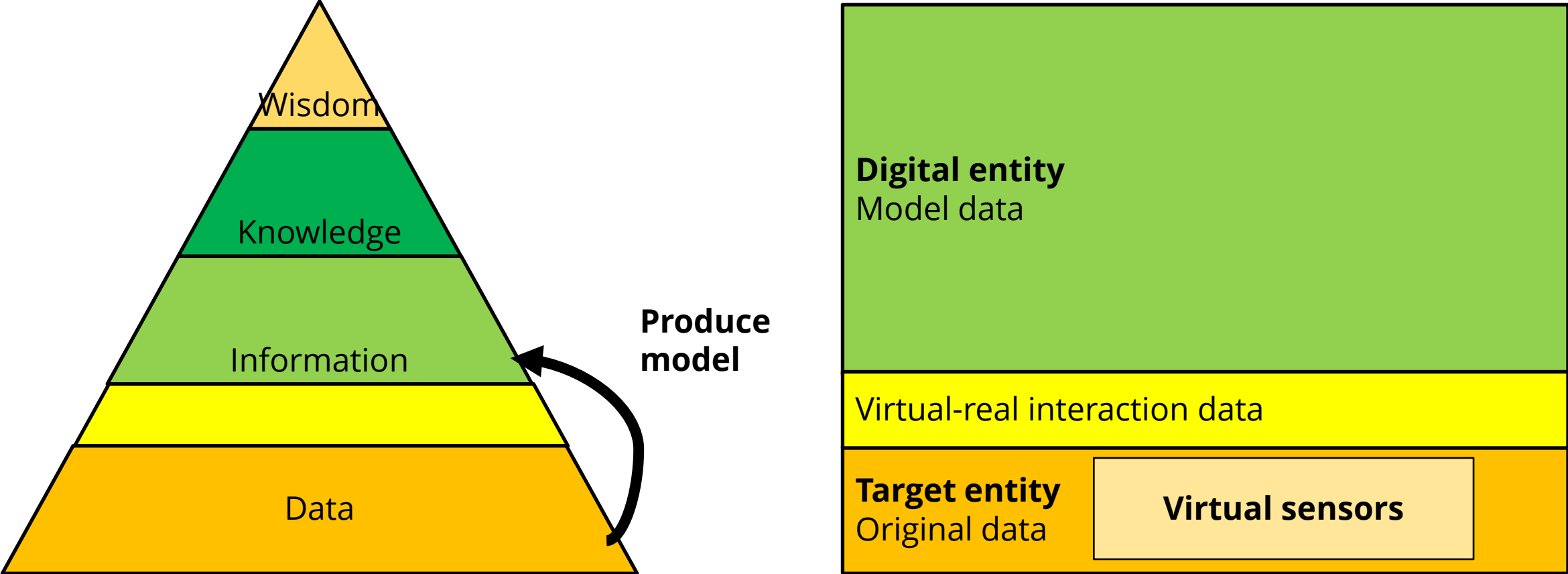
▀ Time

- To be defined

30188 Digital twin reference architecture (publication mid 2026)



PWI Guidance on Integration of IoT and Digital Twin in Data Spaces



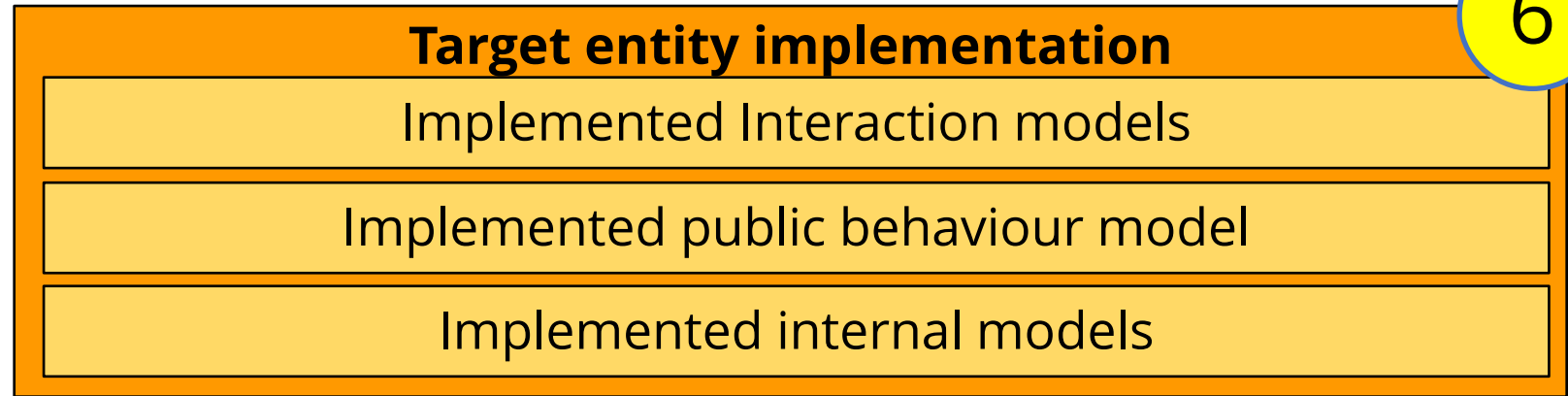
- Mapping DIKW pyramid to digital twins
- Integrating virtual sensors

PWI Policy and Behavioral interoperability

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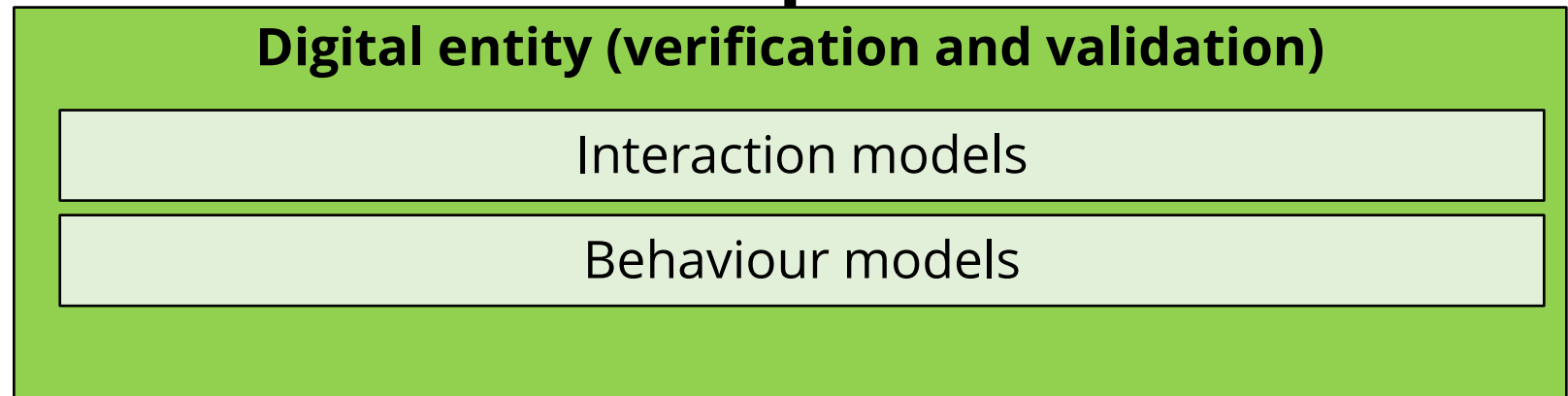
Target entity

- Implements Interaction and public behaviour models



Digital entity verifies and validates behavior of target entity

- E.g. compliance of data usage



30178 IoT Data format, value and coding (Publication end 2025)

PWI Digital twin correspondence measure of DTw twinning



30178 IoT Data format, value and coding

- Background
 - Measurement data
 - Sensor value data
 - Physical quantities
 - Example of data models
 - Interoperability challenges
- Core profile
 - System integration
 - Maximizing the economic value of data through reusability
 - Scalability
 - Semantics
 - Representation vs presentation
 - Resolving data points
 - Data translation
 - Errors and quality
- High-level system design
 - Type safety
 - Sanity-check mechanisms
 - Component manufactory
 - Digitized specification

Correspondance measure of DTw twinning

- Needs fo DTw twinning measures
 - Characteristics of digital twin system against Metaverse, AR, CPS
 - DTw twinning cycle: mutual augmentation
 - How to differentiate human twins
- Analysis of related international standards
 - Quality information framework (ISO 23952)
 - Product data quality (ISO/PAS 26183)
 - Equivalence validation (ISO 10303-62)
 - Hybrid B-rep modeling
 - Measuring the fidelity of digital twin
- Similarity measures
 - How to measure similarity
 - Static similarity measure
 - Temporal similarity measure
 - Similarity measure for 3D CAD models
- Correspondence measure
 - What is twinning correspondence?
 - Hybrid of spatial measure and temporal measures
 - Relation with other DTw projects including maturity level
 - Elements of the correspondence measure



Thanks



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