ISO/IEC JTC1/SC 41 Webinar
IoT and Digital Twin Standardization
April 26 & 28, 2022

Webinar objectives

Attendees will learn about achievements related to standardization in the areas of “Internet of Things” (IoT) and “digital twin” (DTw) technologies since the creation of SC41 five years ago.

Consideration will be given to emergent trends and the future work program in relation to these technologies and some of their applications.

Post-webinar publications

The following material will be available after the webinar:

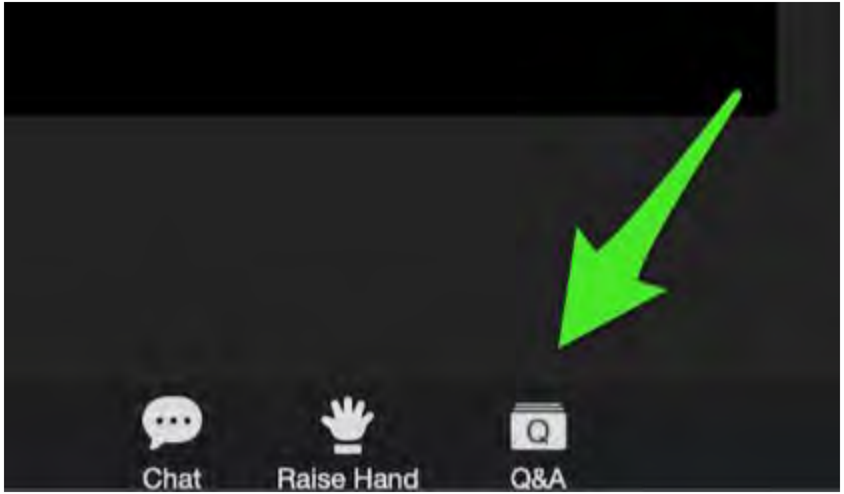
- Presentation material
- Recording
- Edited Q&A

Registered participants will be notified once the material is available.

Questions and answer

Please use the Zoom feature for all your questions.

The webinar program committee and presenters will try to answer your questions asynchronously during the webinar using this Zoom feature.



ISO/IEC JTC 1/SC 41

Title: Internet of Things and Digital Twin

Scope:

Standardization in the area of Internet of Things and Digital Twin, including their related technologies.

1. Serve as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.
2. Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.

Foundational standards

- Concentrate on foundational standards: vocabularies, reference architectures, interoperability, trustworthiness

Program - day 1

12.00-12.15 UTC	Introduction : Dr. François Coallier, ISO/IEC JTC1/SC41 Chair Mr. Philip Wennblom, ISO/IEC JTC1 Chair
12.15-12.35 UTC	IoT and Digital Twin standardization strategy in JTC 1/SC41 Dr. François Coallier, ISO/IEC JTC1/SC41 Chair
12.40-13.00 UTC	IoT Reference Architecture (RA) 2.0 Ms. Erin Bournival, Convener of JTC 1/SC41 WG3 Mr. Eric Simmon, IoT RA Lead Architect Mr. Östen Franberg, IoT RA co-editor

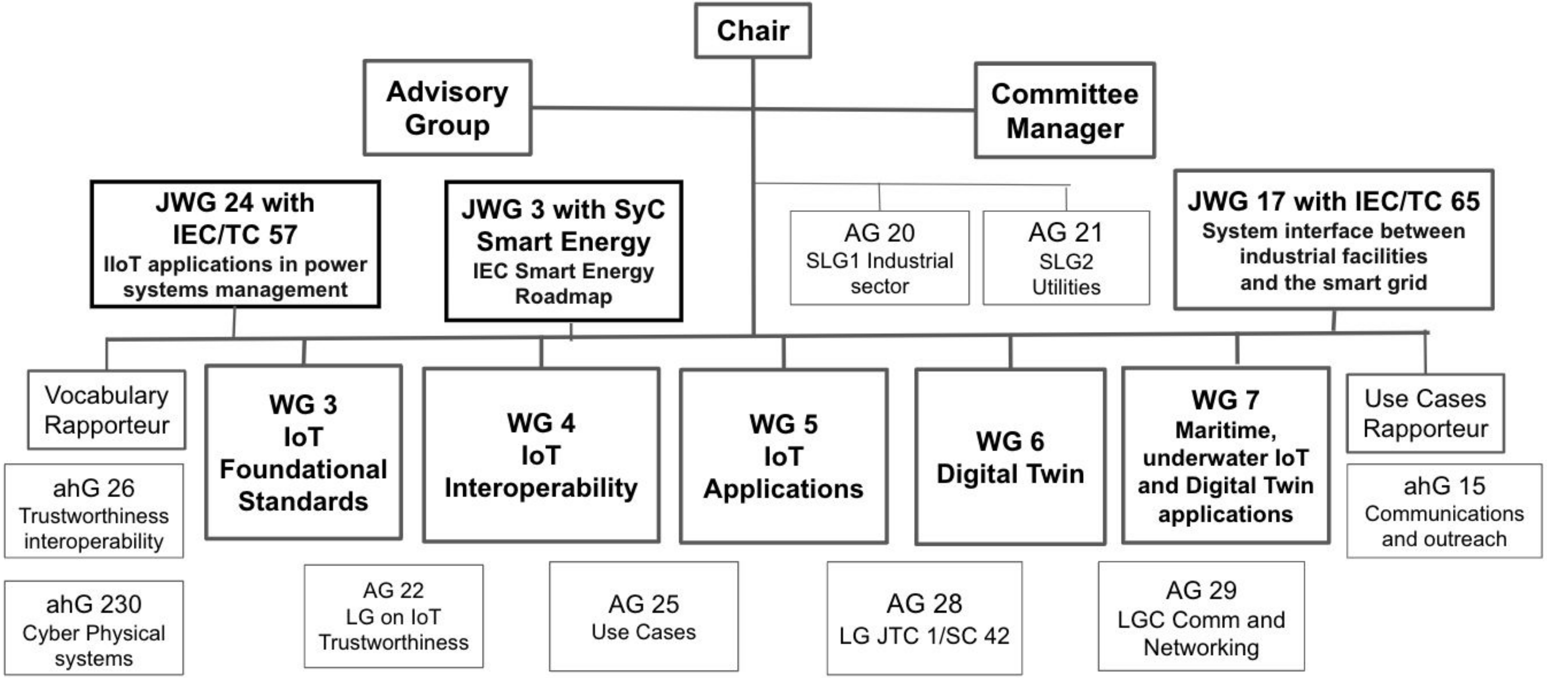
Program - day 1

13.05-13.25 UTC	IoT Interoperability Standardization Dr. Quan Wang, Convener of JTC 1/SC41 WG4 Mr. Antonio Kung Dr. Lan Yamashita
13.30-13.50 UTC	Industrial IoT Standardization Mr. Detlef Tenhagen, Convener of JTC 1/SC41 AG20
13.55 -14.40 UTC	Panel on IoT Trustworthiness Chair: Ms. Erin Bournival, Convener of JTC 1/SC41 WG3 Convener Panelists: Mr. François Coallier, Mr. Antonio Kung, Mr. Asahiko Yamada
14.40 -14.45 UTC	Wrap up

Cooperation with sectors

- Have an ‘incubator’ to kick-start domains or sectors applications and cover ‘dead-angles’
- Coordinate and partner as required with ISO, IEC and JTC 1 entities as well as other Standards Development Organizations (SDOs) that have the mandate and resources to develop standards for technologies used in IoT and DTw systems.
- Coordinate and partner as required with ISO and IEC entities that mandate and resources to develop standards that use IoT and DTw in specific application domains or sectors.

SC 41 Structure (November 2021)



Program - day 2

12.00-12.15 UTC	Introduction : François Coallier (ISO/IEC JTC1/SC41 Chair)
12.15-12.35 UTC	Highlights from the September 2021 SC41 Digital Twin Workshop Dr. Sha Wei, Convener of JTC 1/SC41 WG6
12.40-13.00 UTC	City Information Modelling and Urban Digital Twins Dr. Chunlan Guo, IEC SyC Smart Cities expert
13.05-13.25 UTC	Maritime IoT and Digital Twin Dr. Soo Hyun Park, Convener of JTC 1/SC41 WG7

Program - day 2

13.30-13.50 UTC	IoT and Digital Twin in the Energy Sector Mr. Laurent Guise, IEC SyC Smart Energy and IEC/TC57 Expert, IEC SG12 MG co-convenor
13.55 -14.40 UTC	Closing Panel on IoT Applications and Domain Standards Chair: Dr. Yongjin Kim – Convener of SC41/WG5 Panelists: Dr. Howard Choe, Dr. Kate Grant, Dr. Mingjuan Wu and Mr. Yong-Woon Kim.
14.40 -14.45 UTC	Closure

Highlights from the September 2021 SC41 Digital Twin Workshop

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Dr. Sha WEI, Convenor of WG 6
venessa724@vip.qq.com

Contents

About WG 6

Until Apr. 16th, 2022, there are 174 committee members from 19 NBs in WG 6, including Australia, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, Spain, Sweden, Switzerland, UK and US.

Projects：

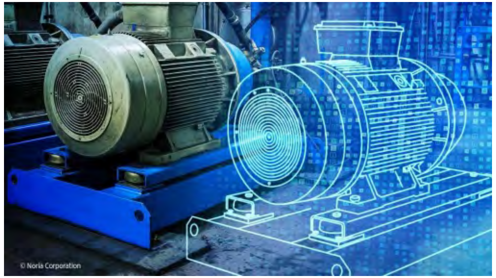
- ISO/IEC CD 30173 Digital Twin - Concepts and terminology
- ISO/IEC CD TR 30172 Digital Twin - Use cases
- PWI JTC1-SC41-5 Digital Twin - Reference Architecture
- PWI JTC1-SC41-6 Guidance for IoT and Digital Twin use cases
- PWI JTC1-SC41-7 Digital Twin Maturity Model

Definition of Digital Twin

digital twin
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 have some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, etc.

Note 2 to entry: Digital twin may provide an integrated view throughout the lifecycle of the target entity.




Workshop objective

- The objective of the workshop was to gather standard experts having an interest on digital twin related standards, in order to reach a common understanding on
  - Use cases
  - Concepts
  - Architecture
  - Integration.

Workshop Outcome

The expected outcome was set to

- Insight on digital twin use cases from different domains e.g., smart manufacturing, smart buildings, smart cities,
- Insight on common concepts for digital twins,
- Insight on common architecture descriptions for digital twins,
- Insight in the alignment of digital twin architecture related standards with other standards (e.g., IoT related standards), and
- Recommendations for standardization.

Workshop Organization

Program committee:

Program committee	Antonio Kung (Chair) Kjell Bengtsson, Jan De Meer, Masatake Sakuma, Detlef Tenhagen, Karim Tobich, Alex Samarin, Sha Wei
Workshop 1 (Digital twin use cases) chairs	Detlef Tenhagen, Sha Wei
Workshop 2 (Digital twin concepts) chairs	Sha Wei, Jan de Meer
Workshop 3 (Architecture of digital twins) chairs	Jan de Meer, Alexander Samarin
Workshop 4 (Digital twin systems integration) chairs	Alexander Samarin, Masakake Sakuma
Workshop Report editors	Antonio Kung, Karim Tobich

Schedule

Workshop 1 Digital twin use cases	16 September 2021, 13.00-16.00 UTC
Workshop 2 Digital twin concepts	21 September 2021, 07.00-10.00 UTC
Workshop 3 Architecture of digital twins	23 September 2021, 13.00-16.00 UTC
Workshop 4 Digital twin systems integration	28 September 2021, 07.00-10.00 UTC

Participants

- ISO/IEC JTC1/SC41
- Experts from ISO TC184
- Experts from ISO/IEC TC184 JWG21/TF8
- Experts from IEC TC65
- Liaison organizations (IIC, AIOTI, …)
- External alliances (Industrial Digital Twin Association, Digital twin consortium, ..)

WS1 - DIGITAL TWIN USE CASES

The workshop did allow identifying:

- **Verticals**: manufacturing, energy, transportation, home, ocean, aerospace, building, robotics, etc.
- **Characteristics**: semantic, interoperability, integration, lifecycles, provenance of data, etc.
- **Problems solved by digital twins**: monitoring the status, energy saving, quality improvement, etc.
- **Challenges**: regulations, organizations, cyber securities, multi-twin interoperability, etc.
- **Actors**: People, Components, Systems, Integrated Systems, Applications and Organizations, etc.
- **KPIs**: conformity, Synchronisation, verification, validation, robustness, fidelity, traceability, reconfigurability, Dependability, etc.
- **Digital Infrastructures**: Computing, Sensors, Artificial Intelligence, Situation-/Context-Awareness, Localization and Tracking, Actuators, Controls, Energy Consumption, Time Synchronization, Management Functions / Risk management, Unique Identification, Database, Networking, IT Security, Data Privacy, Simulations, etc.

Highlight the need to gain from the use of DTw

- Energy/Material Savings
- higher Quality,
- economics of scale (Lot-Size 1 while large scale cost reduction),
- operation efficiency,
- better prediction,
- better planning,
- ability to simulate non-measurable values by model, scenario's, what-if,
- root-cause analysis,
- maintenance,
- advanced control,
- carbon footprint decreasing,
- disaster prevention,
- remote expertise,
- anomaly detection,
- safety intelligence,
- scalability,
- value in the ecosystem,
- willingness to cooperate.

Expectations Resulting from Use Cases

- The workshop did highlight the need to add control/actuation aspect on "Orchestration" between the real world and virtual World as a dual direction of the DTw in real-time as it is an important aspect to the ecosystem of DTws.
- A need to capture flexibility in DTw Use-Cases was raised with eventually an "actuation interface" or as Services.
- The workshop did raise the need to allow **different "Views"** of the same DTw. As an example, FaceBook of a person and a person are also different from each other. Public/Private views on DTw were raised by highlighting the need for that view to be considered, this could be seen as Services.
- The concept of coordination for digital twins was addressed, If more than one DTw works simultaneously a coordination is necessary on the top level!
- DTws' services should also be discoverable to allow flexibility and interoperability.
- During the workshop different challenges were raised like identity and trust management.
- It was suggested to identify commonalities / common "values" out of all the collected DTws use cases in order to regroup the challenges and identify generic concepts.

WS2 - DIGITAL TWIN CONCEPTS

Global Concepts

- **Definition** of Digital Twin was shared during the workshop
- **Life cycle** of Digital Twin was brought to the participant attention
- The notion of a **semiotic triangle** was introduced with its 3 components: Concept, Symbol, and Object. The relation between object and symbol to define DTw concepts was explained: the DTw is in the Symbol space, not the concept space. It was raised that an Object could be seen as a Thing and as an Asset. Experts raised the need to give special care to the idea that for one physical asset may have multiple concepts and multiple symbols.
- DTw is a **strategic orientation** from a business transformation; this is why we should consider Modeling, Ontology, simulation and processes as key enablers.
- When representing the physical entity there is a need for an **engineering-based model**, inspired from the NASA concept of a multi-physics model that represents the physical behavior of the physical entity, e.g. the thermodynamics, hydrodynamics, etc in the swimming pool example

System representation and interface concepts

- entity-of-interests (EoI) and associated DTws were introduced.
- The interface (bidirectional) between the EoI and associated DTw was presented through the concept of Target Digital Integration Gateway (TDIG). It was also presented as an asset administration shell (AAS).
- Interaction between DTw and the real world can use multiple interfaces layers.
- Digital twins can be used to create the link between the cyber world and the physical world. In the case of cyber physical systems (CPS) the interface requires trustworthiness properties (to be characterized).

Discussion on approach to twins

Approach to twins:

- Twins have a decentralized ID
- Twins have semantic metadata about themselves
- Twins have dynamic data "feeds or streams"
- Metadata describes the dynamic data
- Twins "behavior" i.e. the compute part interacts with the static and dynamic data

Approach to ecosystems:

- Data owners have their own space in a network of spaces
- Interactions are brokered between twins in separate or same spaces

WS3 - ARCHITECTURE OF DIGITAL TWIN

A presentation was made on the concept of Reference Architecture (RA). A RA should define some capabilities to address common problems of a domain, however each system (compliant to the RA) may:

- implement only a subset of these capabilities (as core business);
- obtain some capabilities from business partners (remember "GE Predix"), and
- evolve at its own pace

Any RA can be viewed as a set of architecture views and architecture models, e.g., RAMI 4.0 is one of such models focusing on "service classification scheme" . In order to ensure integration, the same architecture description approach should be used, such as ISO/IEC/IEEE 42010 (architecture description).

The twin itself (level 0) VS the twinned system (level 1).

At level 0 characteristics can be defined such as

- purpose
- encoding
- interactions
- analytical capabilities
- self-description
- others

At level 1 methods to define the twinned system should be agreed based on

- capabilities prioritization logic,
- maturity matrix
- platform pattern
- integration examples
- repository of various patterns,
- reference processes.

It was suggested to consider a viable system model (VSM) of the twin.

DTw VS CPS

The workshop raised the question of DTw vs CPS. It was pointed out that there might not be a one-to-one mapping. As an example, an autonomous robot the CPS may have several DTws for

- itself
- object to be produced as a result of the task (e.g., “ bring some logs”)
- surrounding environment for navigation
- objects to be used to fulfil the task

The relationship between the virtual entity & the physical entity

- Architecture pattern # 1: Twins acting concurrently
- Architecture pattern #2: Digital Twin to provide a feedback
- Architecture pattern #3: Digital Twin to provide feed forward directives

Interoperability-by-design

The workshop raised the concept of Interoperability-by-design which led to different questions about standardization of:

- Protocols
- Data schema
- Semantics
- Capabilities
- Processes
- Policies
- Methodology
- Solutions
- Governance
- Management
- Operations

WS4 - DIGITAL TWIN SYSTEM INTEGRATION

Integration issues in smart buildings are worth mentioning as they many of them were valid for other domains:

- need for global and detailed view
- need for ontology
- supporting existing systems
- hardware for deployment of system software (e.g. BOS - building operating system) in the case of an IoT (edge/cloud) environment
- multiple driver management
- data characterization
- scalability of model
- end-to-end security
- end-to-end customer path


Smart society
Smart healthcare
Smart transport
Smart territory improvement
Smart payments
Smart buildings
Smart energy
H
Thank You!
https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/

ANNEXES

City Information Modelling and Urban Digital Twins

Dr Chunlan Guo

IEC SyC Smart Cities

28 April 2022

Content

- Definitions
- Case study: A city level CIM platform in Nanjing, China
- Case study: New South Wales spatial digital twin
- The overlaps and differences between CIM & UDT
- The challenges to the deployment of CIM & UDT
- Standards and other developments required for CIM & UDT

3 Definitions

city information modelling

CIM

development of digital representations and simulations of a city made up of large quantities of geospatial data, often including real time data, which enable better city planning and management

Note 1 to entry: The geospatial data is provided using an integration of building information modelling (BIM) and geographic information systems (GIS).

Note 2 to entry: The real-time data is obtained through extensive use of IoT sensors within the city.

Note3 to entry: city information modelling involves handling large amounts of big data, which is generally brought together using cloud computing.

Note4: Artificial intelligence is often used to generate and evaluate different scenarios using city information modelling data to help manage the city better.

[Source: IEC SRD 63273 ED1 CD]

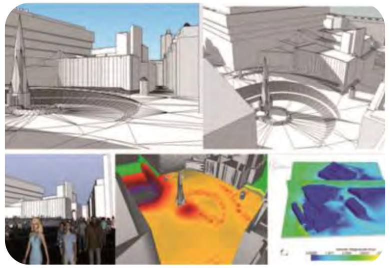


Figure: Charlton et al., 2015; Reitz & Schubiger-Banz, 2014.

digital twin

DT

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 twins have some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, etc.

Note 2 to entry: Digital twin may provide an integrated view throughout the lifecycle of the target entity.

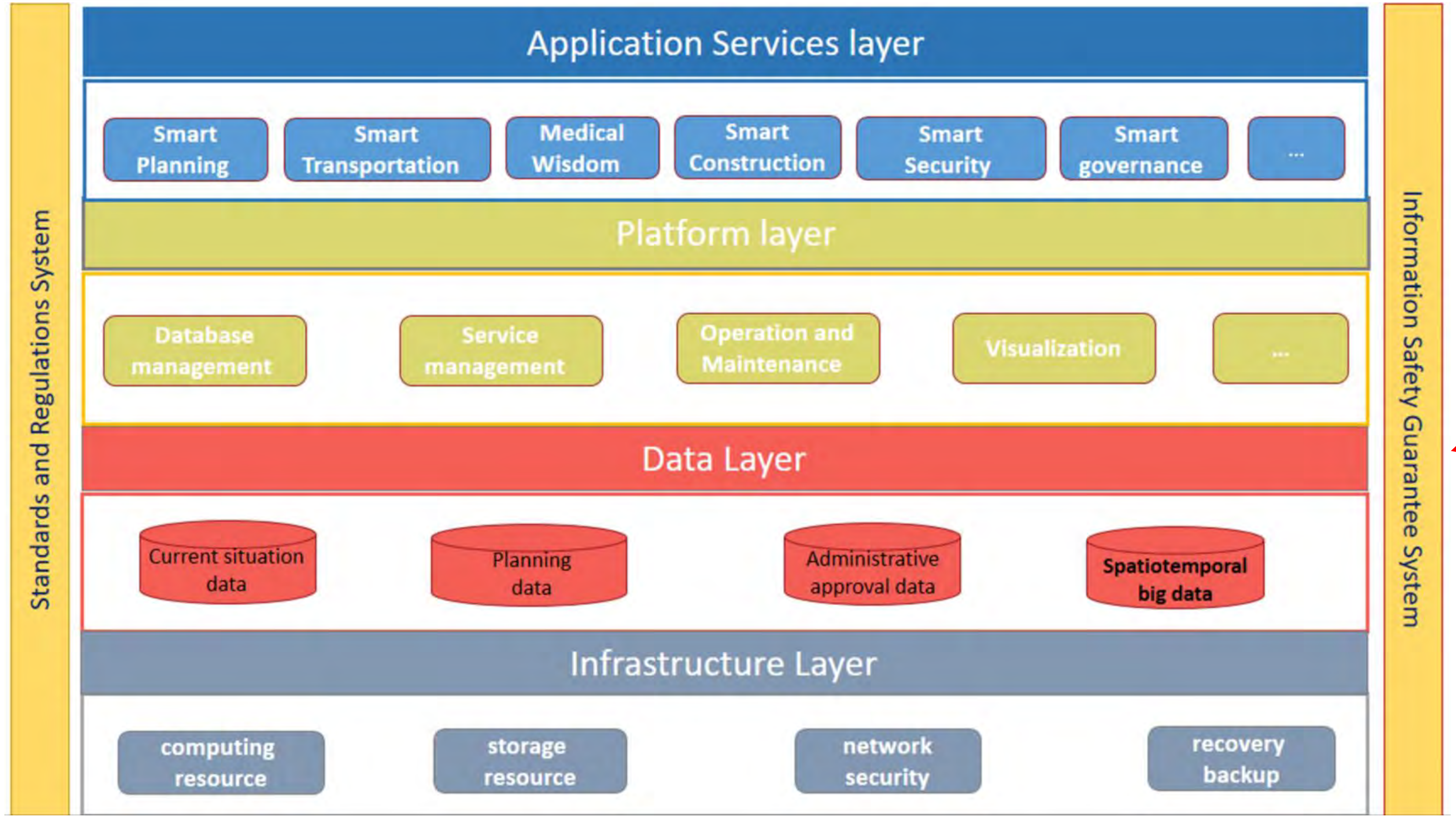
[Source: ISO/IEC CD 30173]

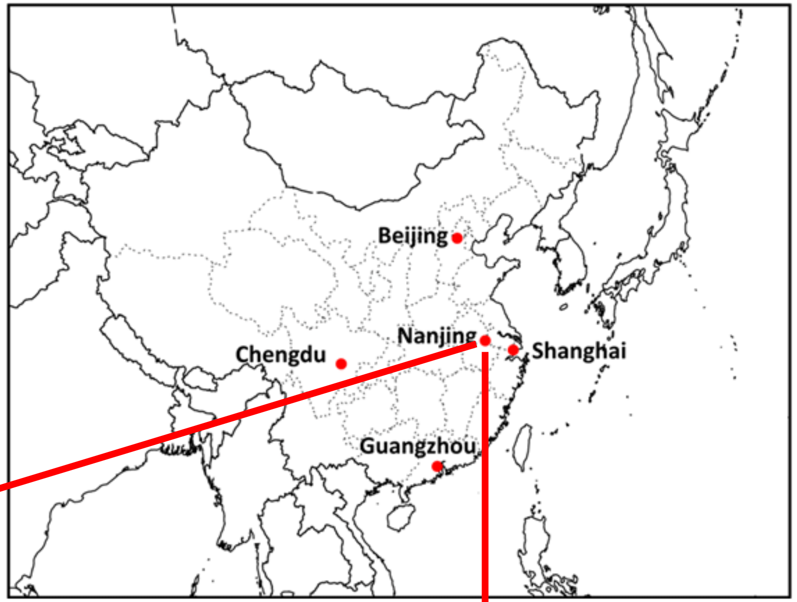
urban digital twin

UDT

digital twin at the urban scale deployed to enable the transformation of how cities are planned, built and managed in order to deliver better services to make the urban environment more livable, inclusive, safe, resilient and sustainable

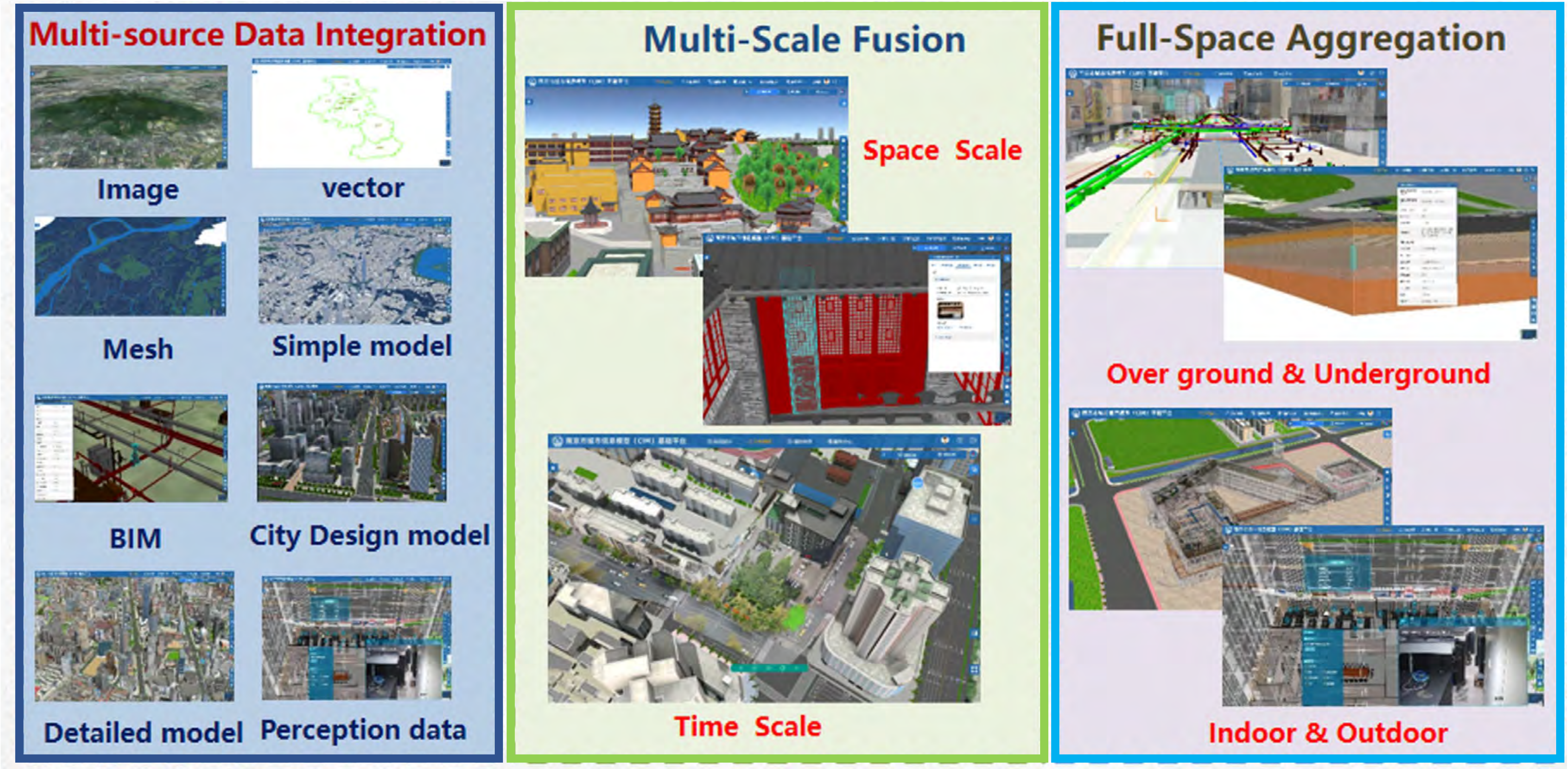
4 Case study: A city level CIM platform in Nanjing, China (1)





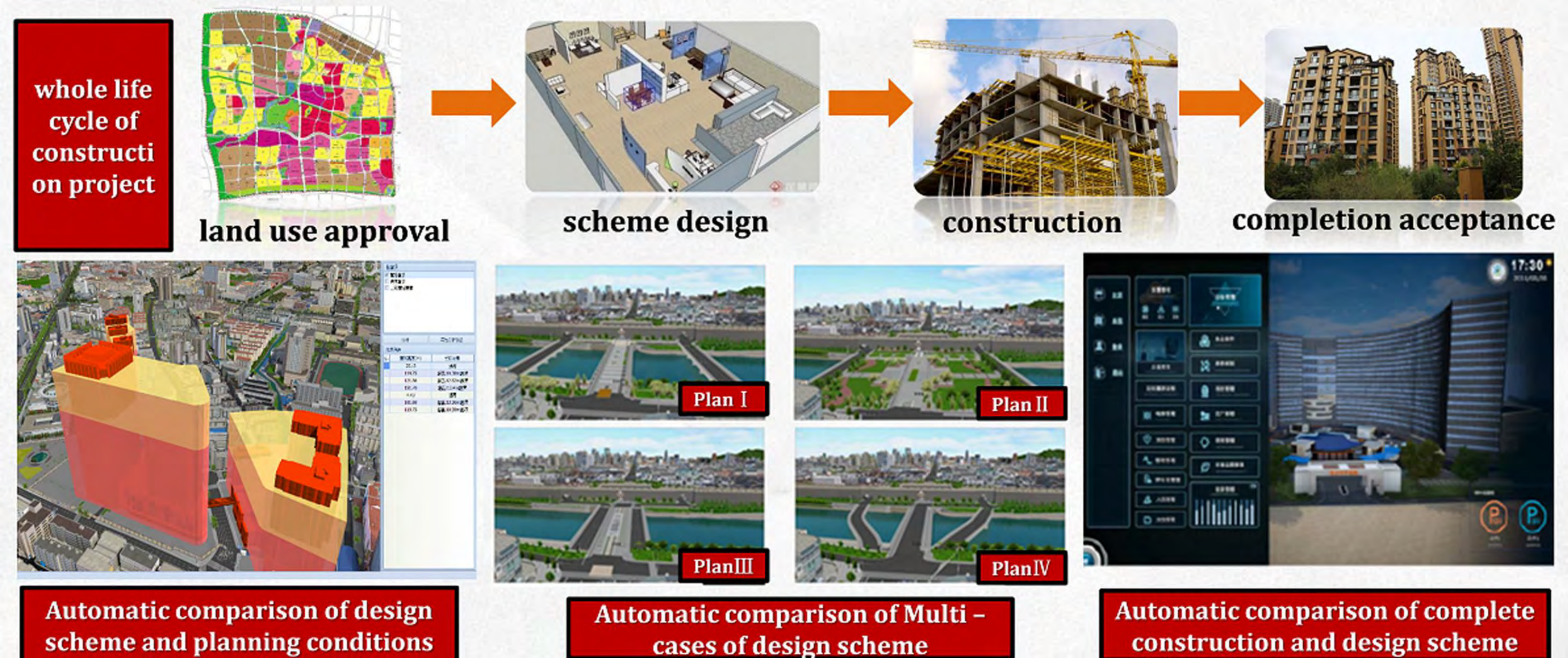
The architecture of the Nanjing CIM platform

Case study: A city level CIM platform in Nanjing, China (2)



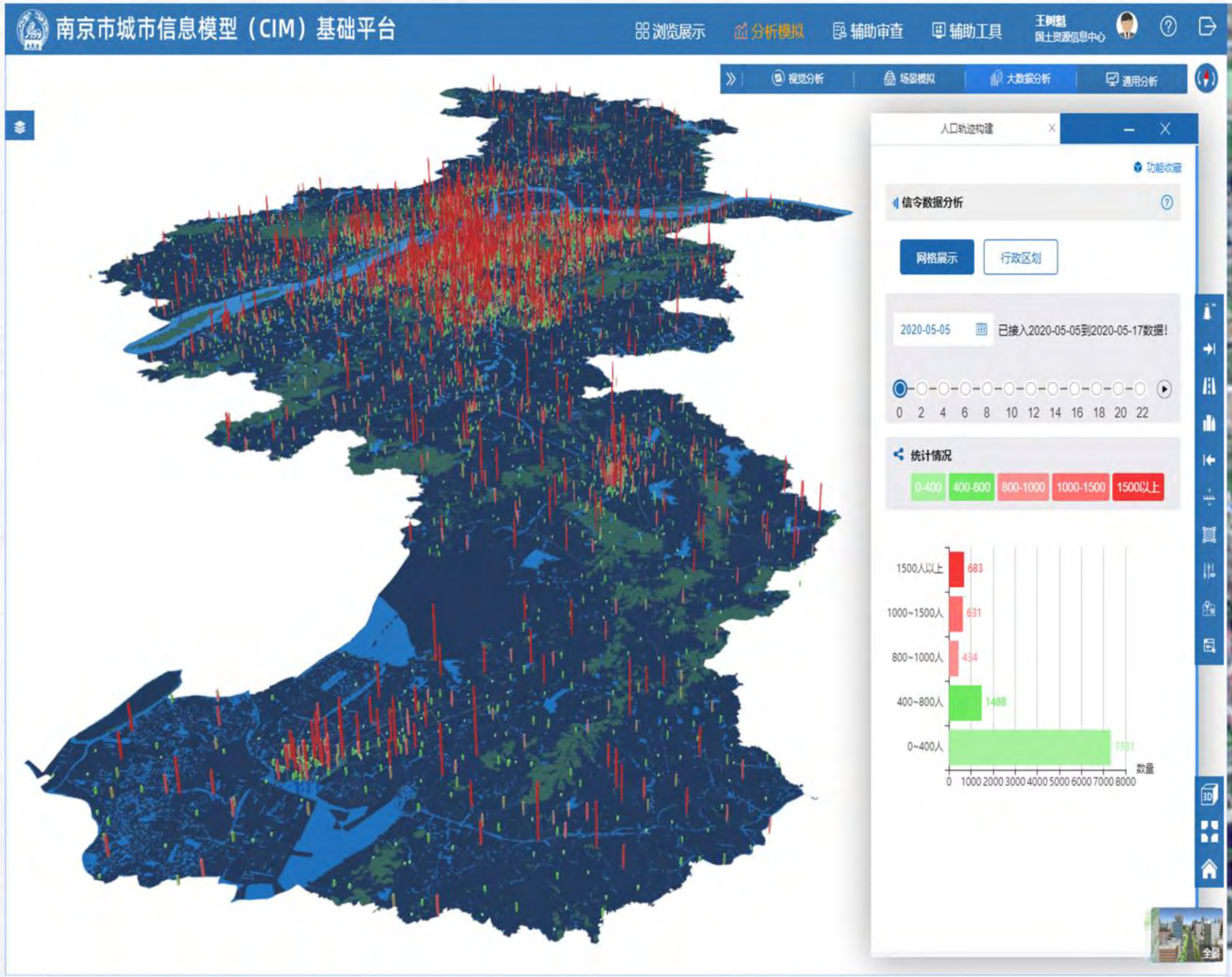
Different data in the Nanjing CIM platform

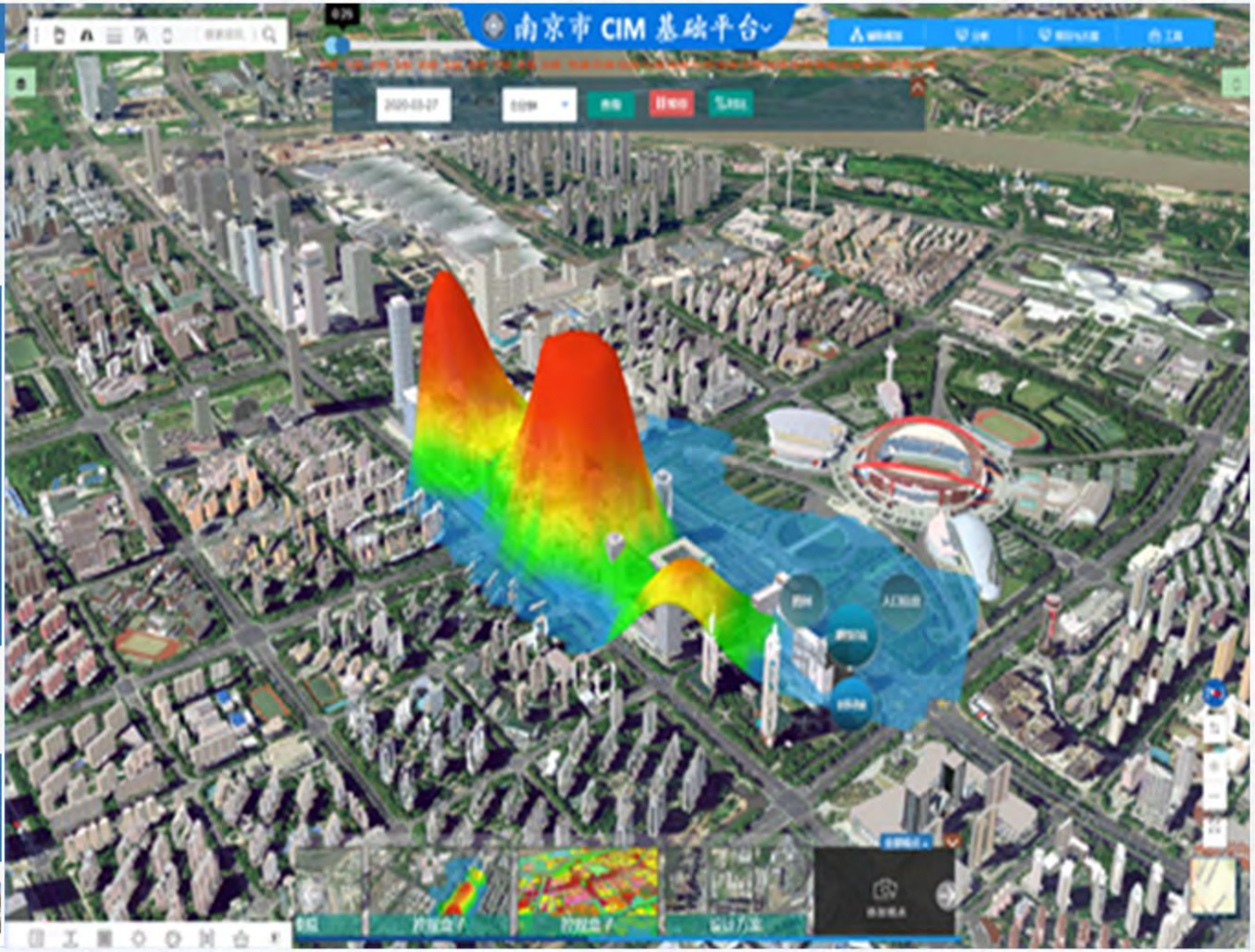
Case study: A city level CIM platform in Nanjing, China (3)



Applying CIM in the whole life cycle of construction projects

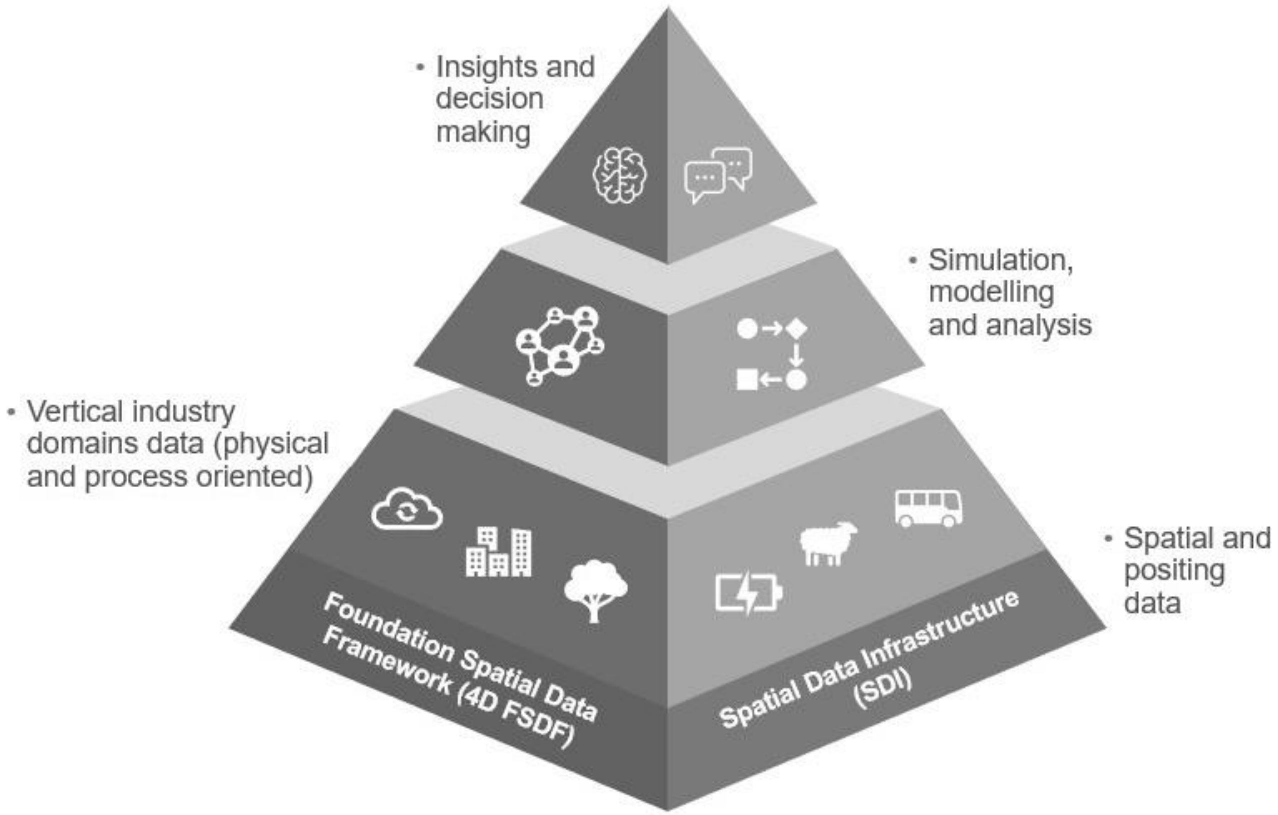
Case study: A city level CIM platform in Nanjing, China (4)





Application of "flow" data (e.g. population, mobile phone signals)

8 Case study: New South Wales spatial digital twin (1)

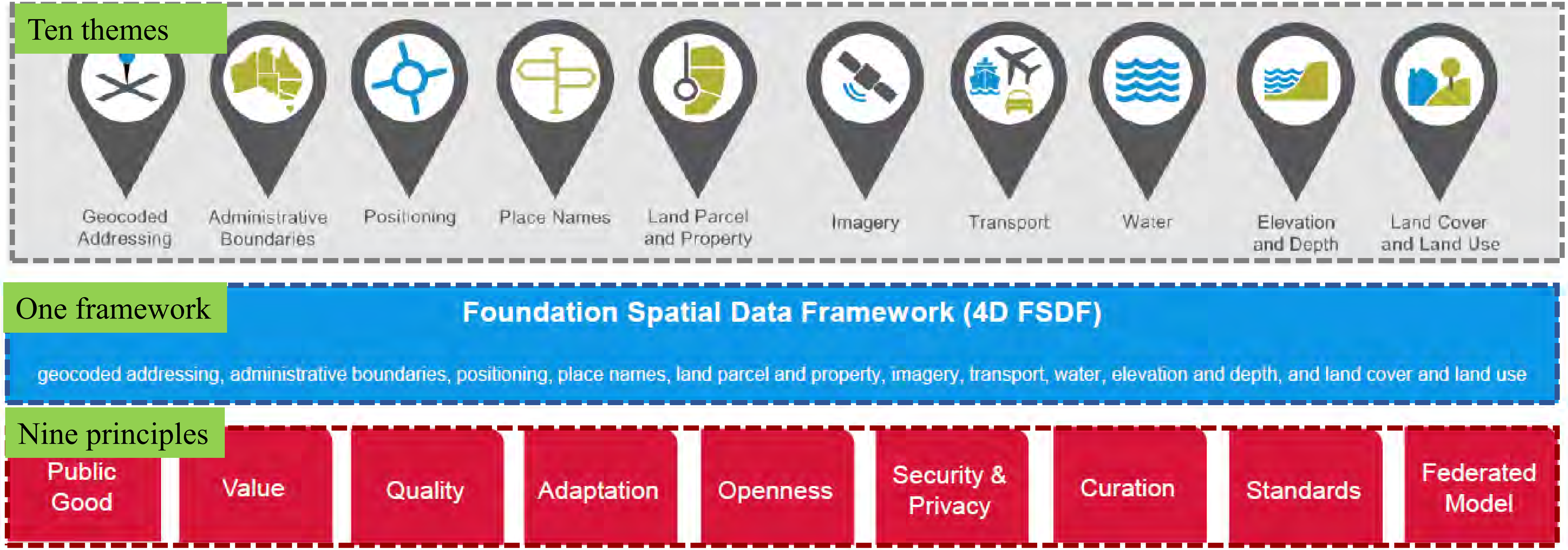


The framework of urban digital twins in New South Wales, Australia

Urban decision-making: focus and tools

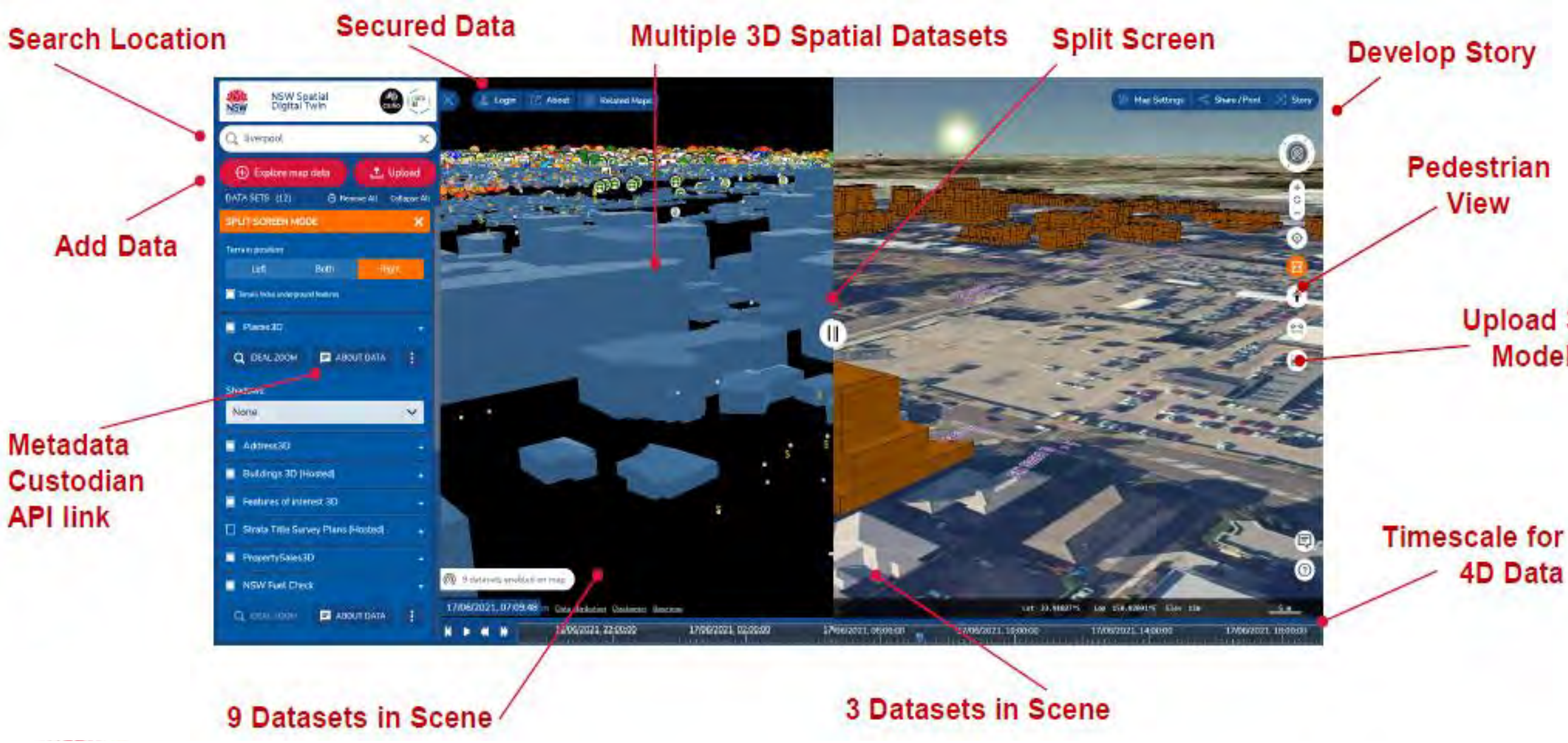
Urban decision-making	Spatial analysis tools
Place-based design	Cluster
Land use	Proximity
Planning	Simulation
Liveability analysis	Modelling
Subterranean infrastructure	Nearest neighbour analysis
Resilience planning	Buffer zone
Health	Geometry analysis

Case study: New South Wales spatial digital twin (2)



The structure of New South Wales spatial digital twin

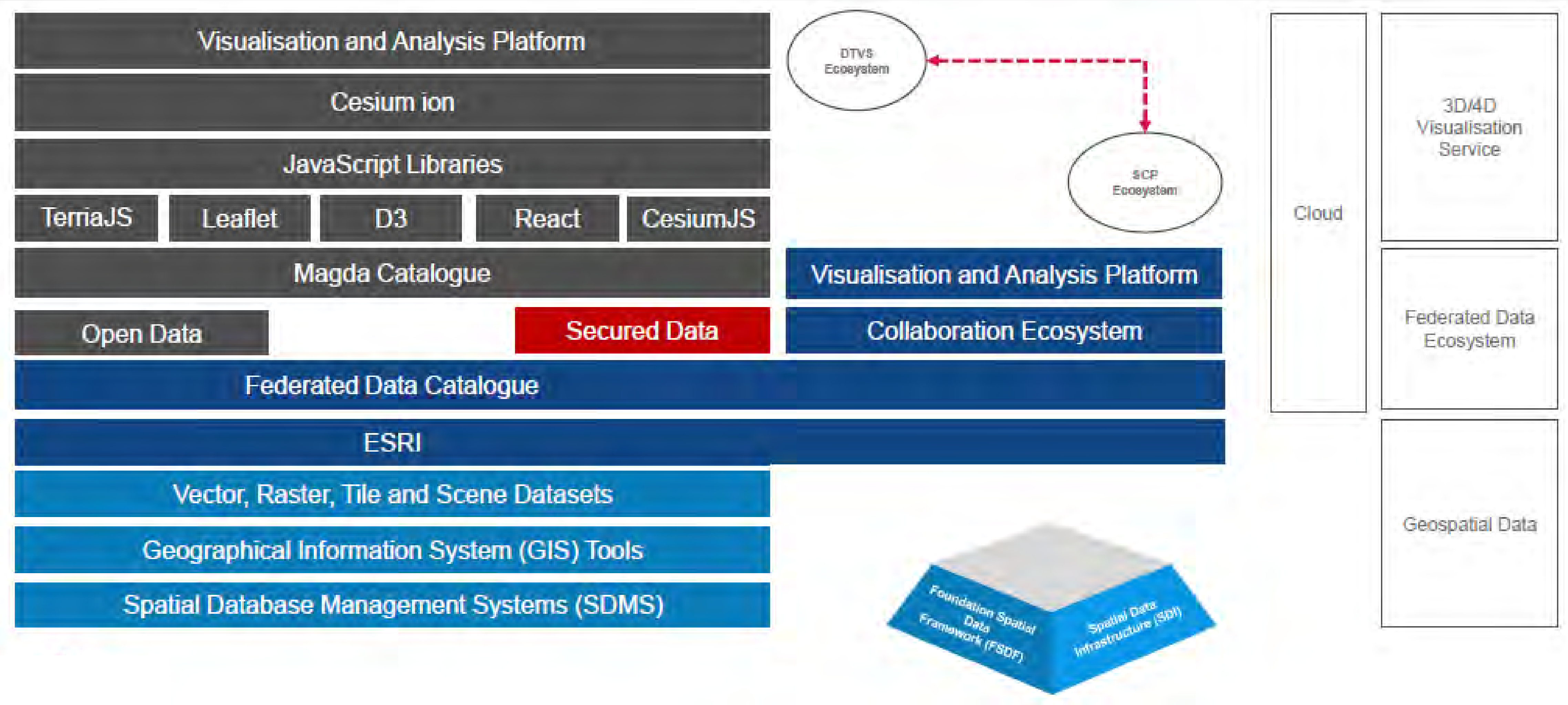
Case study: New South Wales spatial digital twin (3)



The platform interface: selected key features

Website of New South Wales spatial digital twin: https://nsw.digitaltwin.terria.io/

Case study: New South Wales spatial digital twin (4)



Technology stacks and systems of the New South Wales spatial digital twin platform

The overlaps and differences between CIM & UDT

Overlaps

- Aims: To enable better urban planning and city management (maintenance, monitoring and modelling the city and urban environment) by using data and smart technologies

- Functions: comprehensibly model city infrastructure digitally, trace the physical object in the city, monitor and simulate the object in virtual spaces, progress through physical to digital transformation activities, monitor the interaction between the digital and physical worlds

- Data: Integrate multiple data from different sources and involve different formats and different levels (micro, meso, and macro)

- Technology support: Both CIM and UDT are reliant on developing technologies, such as GIS, IoT, big data, could computing and AI.

The overlaps and differences between CIM & UDT

Differences

City Information Modelling	Urban Digital Twins
• CIM has arisen from BIM as foundational data in the modelling and development of city data management • BIM and GIS are two critical important foundations for CIM	• The concept of digital twins originated in mechanical engineering and the Finite Element Method • Digital twins emerged from manufacturing such as those conducted by NASA and Formula One racing cars
• CIM can be seen to show a preference for the model, tooling and technologies	• UDT can be seen in their composition as discrete ecosystems that can be linked, this reflecting back to the origins of technology within the product and facility twinning
• CIM employed a built environment context at an early stage of its theoretical developments	• UDT focus on the transformation of the physical into the virtual world, and the reactions and simulations that occur between the virtual and physical environment
• CIM starts from the perspective of the whole city and solutions affecting the city as a whole	• UDT can be seen emerging from this smaller product and component viewpoint to the larger contextual environment
• Proponents of CIM see the value of the model of the city they can generate, not only to plan but also to help with the ongoing management of the city	• UDT brings the experience from industry of using digital models not only to predict, but also to monitor and manage performance

The challenges to the deployment of UDT and CIMs

Challenges

- Both CIM and urban digital twins are still at an early stage, and they face common challenges and questions for their future development
  - Including data silos, the usability and usefulness of applications for stakeholders, integration/interoperability, openness, regulation, and the development of the necessary skills and education
- Models, data, and software are important components for both CIM and UDT and both need to meet the challenges of data collection, data management and security sharing
- We need standards that address the following issues:
  - How can the different disciplines be aligned, and technologies be linked in CIM and UDT?
  - What are the standards for convergence of different types of data in CIM and UDT?
  - How can the public be involved in the development and usability of CIM and UDT when used for consultation and to support citizens in managing their lives in the city?
  - How can CIM and UDT support the communication between humans and virtual environments?

Standards and other developments required for CIM and UDT

- An integrated reference architecture of CIM and UDT needs to be developed.
- Enabling the connection of different types of city data needed by CIM and/or UDT should be one of the focuses for standards work.
- A full set of use cases of CIM and UDT for different application areas/scenarios is needed to identify the requirement of standards for CIM and UDT.
- Standards for CIM and UDT platforms are needed.
- Collaborative standards work among the different SDOs is vital to develop effective standards for CIM and UDT.
- The above challenges/work required the researchers, front-line practitioners, standards workers, policy makers and other stakeholders to work together for a breakthrough.

16 Standards and other developments required for CIM and UDT

IEC

Technology Report

City information modelling and urban digital twins

iec.ch/basecamp/city-information-modelling-and-urban-digital-twins

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City information modelling and urban digital twins

2021-12-01

Available for download: English

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The development and delivery of smart cities involves many different systems, types of data, and sets of information. This complexity, and the dynamic interaction between the large numbers of stakeholders and city systems, makes planning and managing cities a great challenge. Without a tangible operational model to combine cross-sector data and information, the holistic, cross-boundary planning of cities, districts and neighbourhoods remains constrained. Therefore, new and effective tools are needed to enable the delivery of better city services and to make the urban environment more liveable, inclusive, safe, resilient and sustainable.

City information modelling (CIM) and urban digital twins (UDT) are two emerging technologies for smart cities that aim to provide such tools. Both offer solutions for data processing, urban analysis, design, simulation and modelling. They connect all involved stakeholders and actors to collaboratively deliver the vision of a smart city: a sustainable, inclusive, healthy, prosperous and participative city. They provide solutions for smart cities based on open standards and a multiscale and multitemporal database that integrates a wide variety of data sources presenting the full range of smart urban features, systems and processes.

https://www.iec.ch/basecamp/city-information-modelling-and-urban-digital-twins

Acknowledgement

- Michael Mulquin, IEC SyC Smart Cities
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- Richard Ferris, Independent Consultant, Australia
- Sha Wei, ISO/IEC JTC 1/SC 41
- Vi Le, BridgePoint Advisory, Australia
- Wayne Patterson, Spatial Services, NSW Government, Australia
- Yiling Jian, Guangdong Guodi Planning Science Technology Ltd., China
- Biao Liu, IEC SyC Smart Cities

Thank you

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Maritime IoT and Digital Twin

April 28th, 2022

WG 7 Convenor: Soo-Hyun Park

ISO JTC 1 IEC

INFORMATION TECHNOLOGY STANDARDS

Outline

- Maritime IoT
- Digital Twin Applications of the Ocean
- SC 41/WG 7 Standard Roadmap
- Conclusion

Contributors

- Howard Choe (United States of America)
- Arto Toppinen (Finland)
- Mohan Krishna Varma N (India)
- Axbjorn Hovstø (Norway)

This material is based on the presentations of the WG7 workshop held on Feb 9th, 2022.

1. Maritime IoT

❑ IoT in the Ocean Environment

- The IoT is a system concept that use many technologies that are standardized by other JTC 1 entities and standards development organizations (SDOs) ranging from networking and Digital Twin to cloud computing and AI.

- Maritime and Underwater IoT can use many technologies from networking to applications, and a variety of SDOs might standardize it.

Source: https://www.aberdeen.com/featured/darpa-ocean-things/

1. Maritime IoT

❑ Maritime Definition

- **Maritime is connected with the sea, especially in relation to seafaring commercial or military activity (From Oxford Languages).**

- **Maritime is most everything connected to the sea or waterways throughout the world, especially in relation to navigation, shipping, and marine engineering.**

Source by Howard Choe's presentation material (Refer to SC41WG7N033)

❑ Maritime Industry

- Deep-sea merchant fleet, tugs and barges, port and terminal operations, pilotage, freight forwarding, chartering, intermodal services, admiralty law, passenger and excursion services, lakes and inland waterways shipping, shipbuilding and repair, **naval architecture and marine engineering**, seaman training, government programs and shipping, vessel classification, marine insurance, communications, recreational boating, and much more.

- **The impact of Naval Architecture, Marine and Ocean Engineering is far-reaching and greatly enhances our quality of life. For example:**
  - 74% of the world's trade is carried by ship.
  - 95% of the U.S. international trade is transported by ship.
  - 55% of the U.S. population lives within 50 miles of a coastline.
  - 60% of the U.S. energy is imported by ship.

https://www.sunymaritime.edu/about/visiting-maritime/maritime-museum/maritime-industry

Source by Howard Choe's presentation material (Refer to SC41WG7N033)

❑ Maritime IoT Applications & Possible Use Cases

Maritime IoT Applications

1. Marine equipment monitoring
2. Marine equipment remote maintenance
3. Hull load control system
4. Advanced weather routing
5. Cargo handling equipment monitoring and automation
6. Streamlining port operation
7. IoT utilization for ship design

Maritime IoT Use Cases

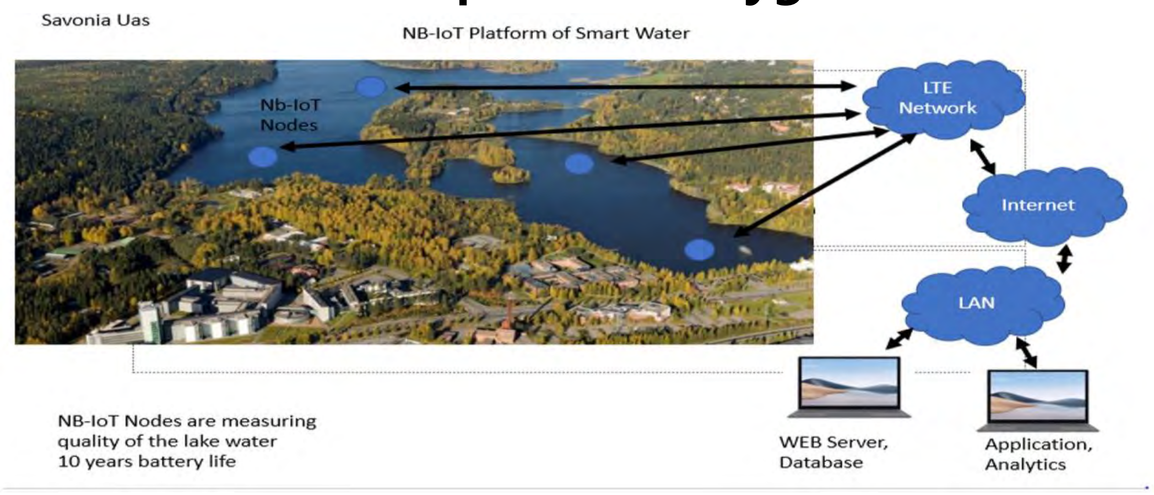
1. Efficient and predictive maintenance for engine and other equipment
2. Realize remote maintenance from onshore
3. Not yet in practice, but using control system, decrease the fatigue load
4. Improve the accuracy of fuel consumption and weather condition
5. Better maintenance and operation of cargo handling equipment and remote operations
6. Improve the efficiency of port operation by logistics planning of all cargos and accuracy of port management
7. Information exchange for designing ship can be more efficient

Hiekata, K., Wanaka, S., Mitsuyuki, T. *et al.* Systems analysis for deployment of internet of things (IoT) in the maritime industry. *J Mar Sci Technol* 26, 459–469 (2021). https://doi.org/10.1007/s00773-020-00750-5

Source by Howard Choe's presentation material (Refer to SC41WG7N033)

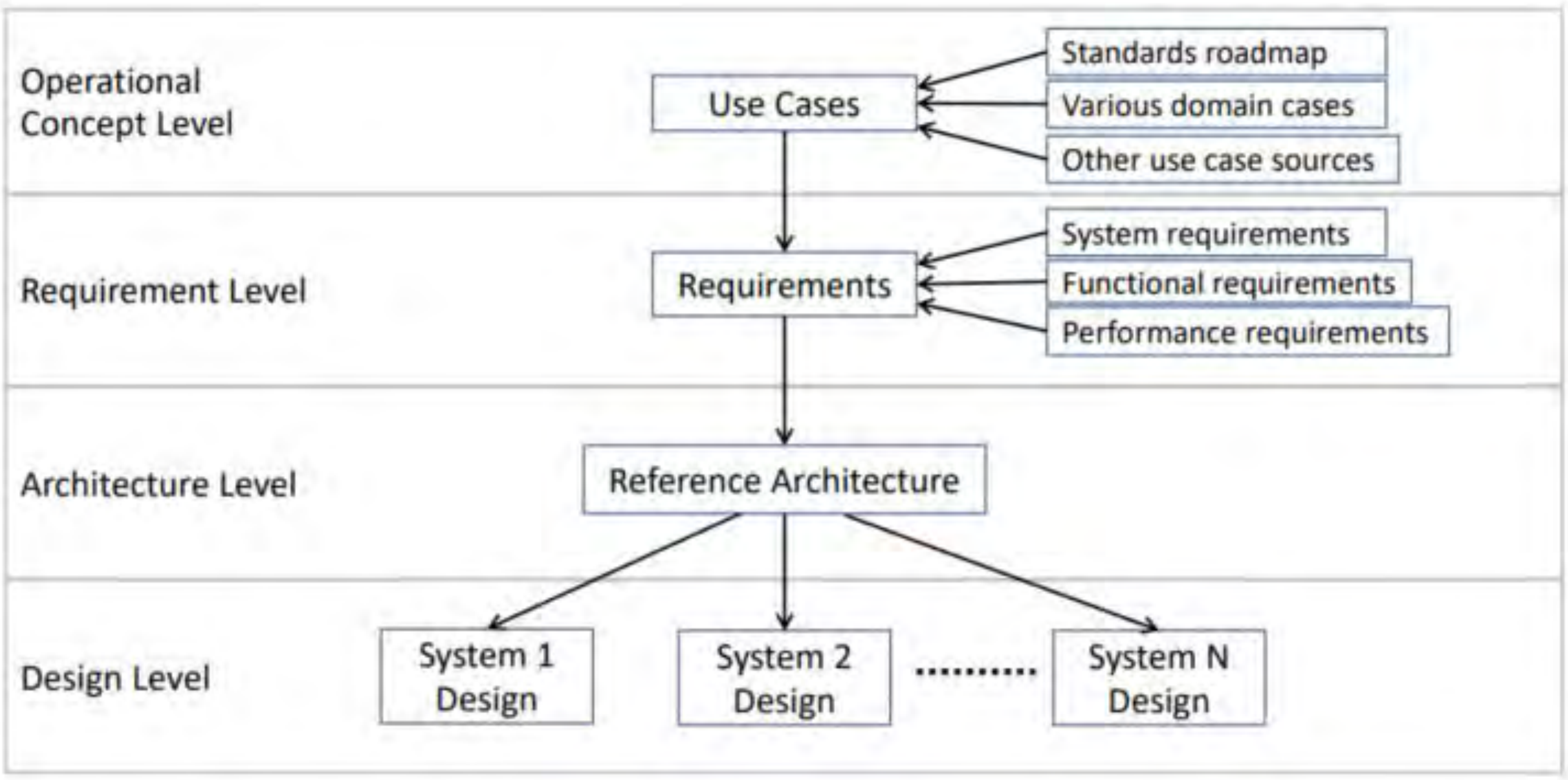
❑ Example of Environmental Monitoring Use Case

- From the perspective of European countries
- Use case supports maritime environmental monitoring of lakes and seas. Lake condition is controlled very carefully in European Union areas. Real-time control systems are needed.
- Aim is to use a modern IoT wireless network of private NarrowBand IoT (NB-IoT) to send data to the cloud for analysis. The measurement uses ordinary sensors like temperature, salt content, poisons, oxygen content, color, clearness, etc.



Source by Arto Toppinen's presentation material (Refer to SC41WG7N033)

❑ Reference Architecture Development Methodology



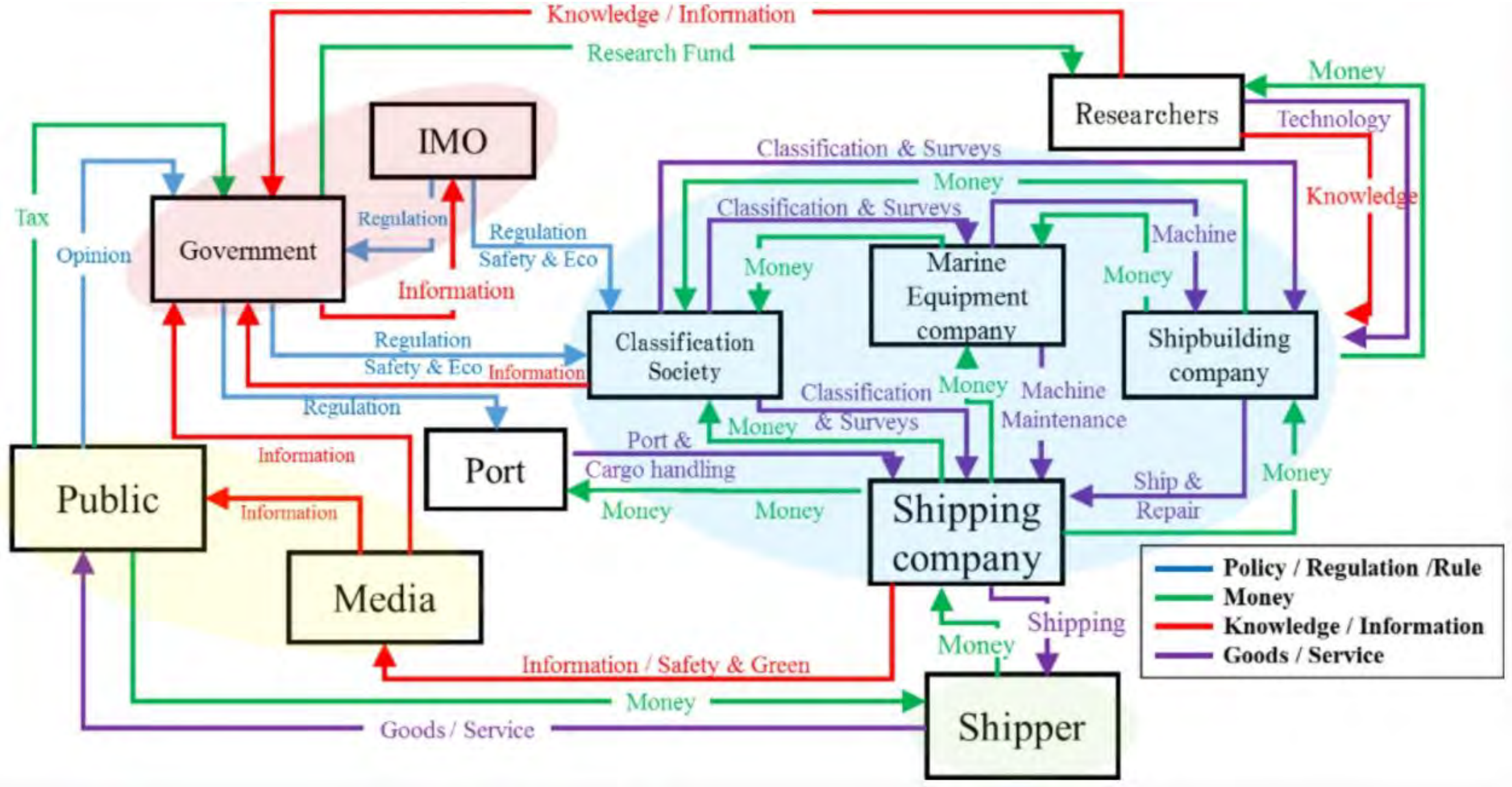
Source by Howard Choe's presentation material (Refer to SC41WG7N033)

❑ Target Life Cycle Phases to Collect Maritime IoT Use Cases

- **ISO/IEC CD 30172 Digital Twin — Use cases**
  1. Inception phase
  2. Design and development phase
  3. Verification and validation phase
  4. Deployment phase
  5. Operation and monitoring phase
  6. Re-evaluate phase
  7. Retirement phase

Source by Mohan Krishna Varma N's presentation material (Refer to SC41WG7N033)

❑ Stakeholder Value Network (SVN) of Maritime Industry

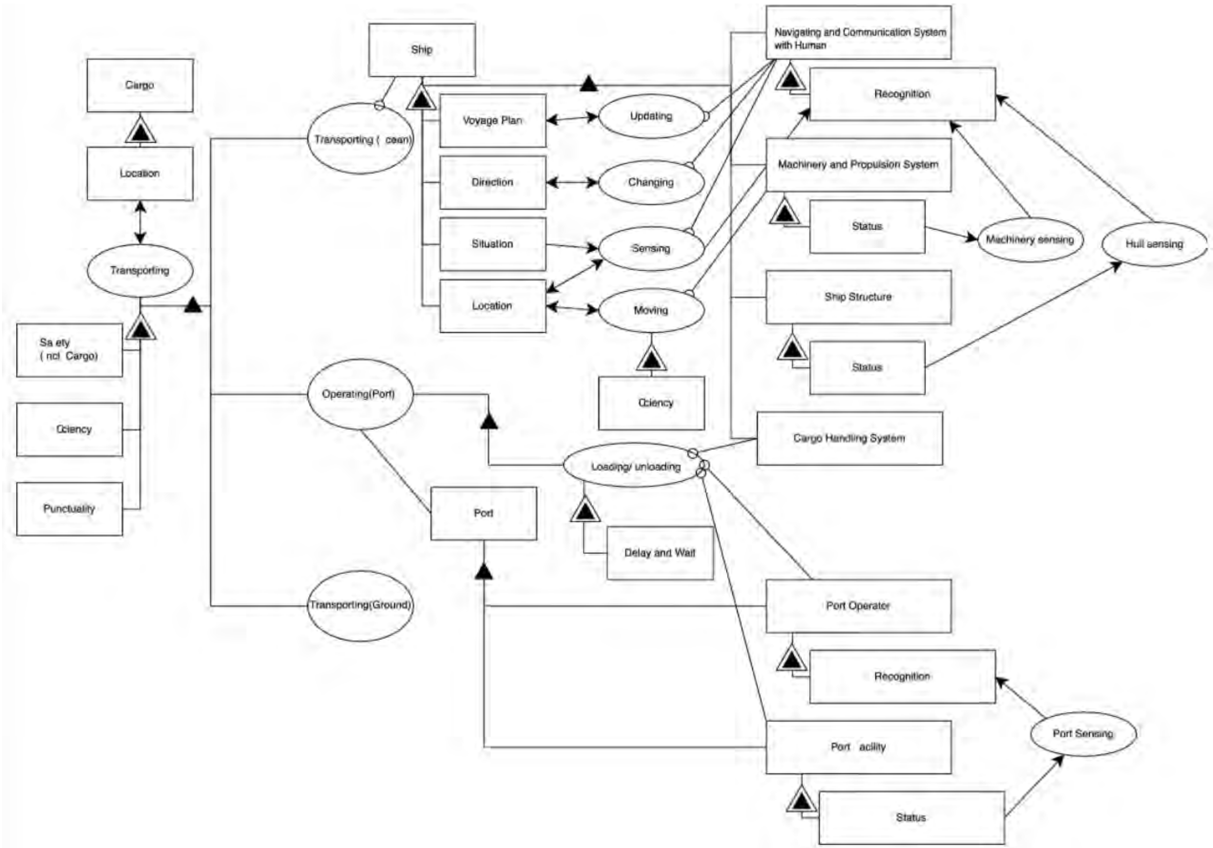


Hiekata, K., Wanaka, S., Mitsuyuki, T. *et al.* Systems analysis for deployment of internet of things (IoT) in the maritime industry. *J Mar Sci Technol* 26, 459–469 (2021). https://doi.org/10.1007/s00773-020-00750-5

Source by Howard Choe's presentation material (Refer to SC41WG7N033)

❑ System Architecture of Maritime Industry Modeled by Object Process Methodology (OPM)

OPM is a conceptual modeling language and methodology for capturing knowledge and designing systems.

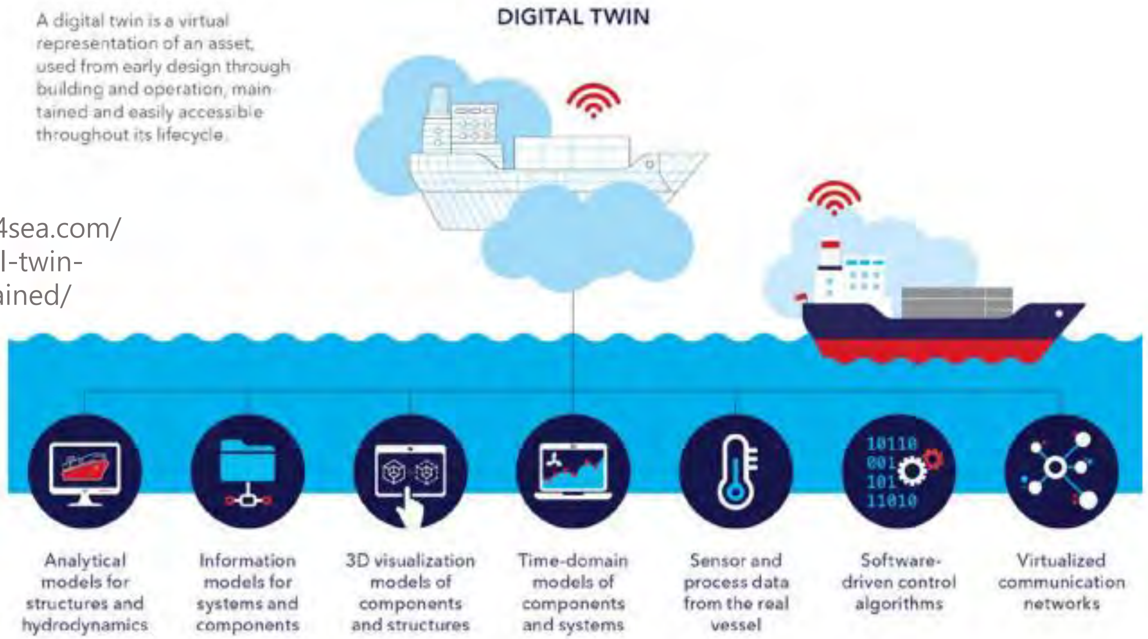


Hiekata, K., Wanaka, S., Mitsuyuki, T. *et al.* Systems analysis for deployment of internet of things (IoT) in the maritime industry. *J Mar Sci Technol* 26, 459–469 (2021). https://doi.org/10.1007/s00773-020-00750-5

Source by Howard Choe's presentation material (Refer to SC41WG7N033)

❑ Digital Twin for the Maritime Sector

- A digital twin is replicated as a unique physical object and processed by an appropriate use case. Data from various digital twins can be aggregated in real-world entities such as a port, ship, buoy, bridge, aquafarm, autonomous underwater vehicle.
- Mirroring real-world entities with digital twins is performed through synchronization.



Source: https://safety4sea.com/cm-the-digital-twin-concept-explained/

❑ Maritime Transportation Digital Twin

Maritime transportation IoT

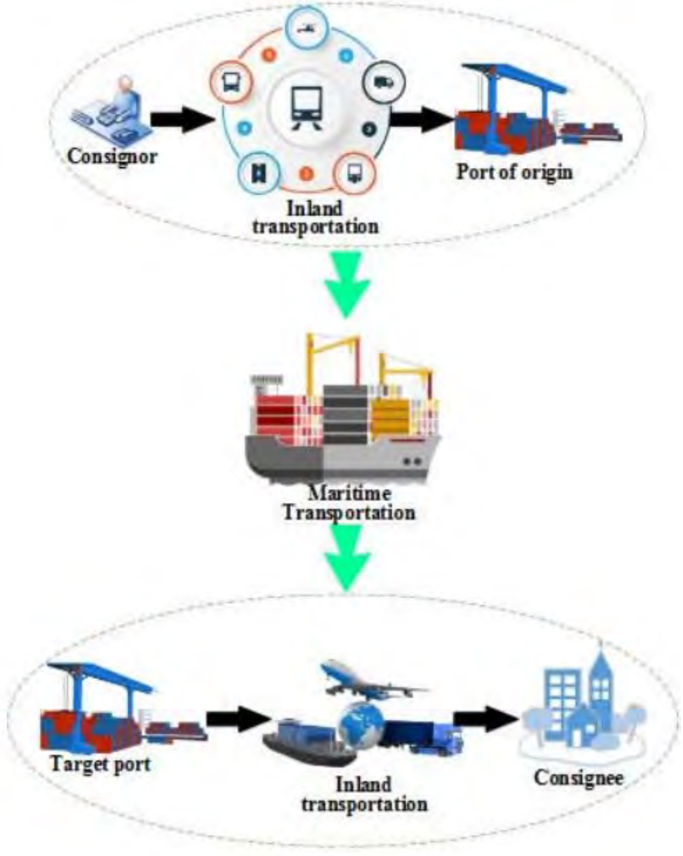


Fig. 1. Business flowchart of maritime transportation IoT.

Maritime transportation Digital Twin model of relay cooperation IoT

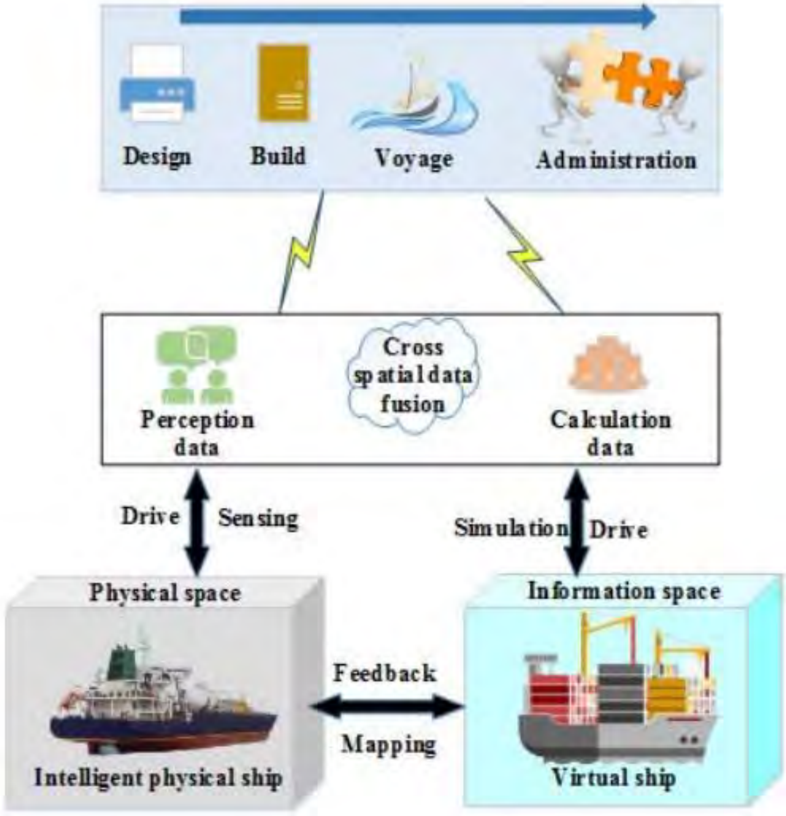
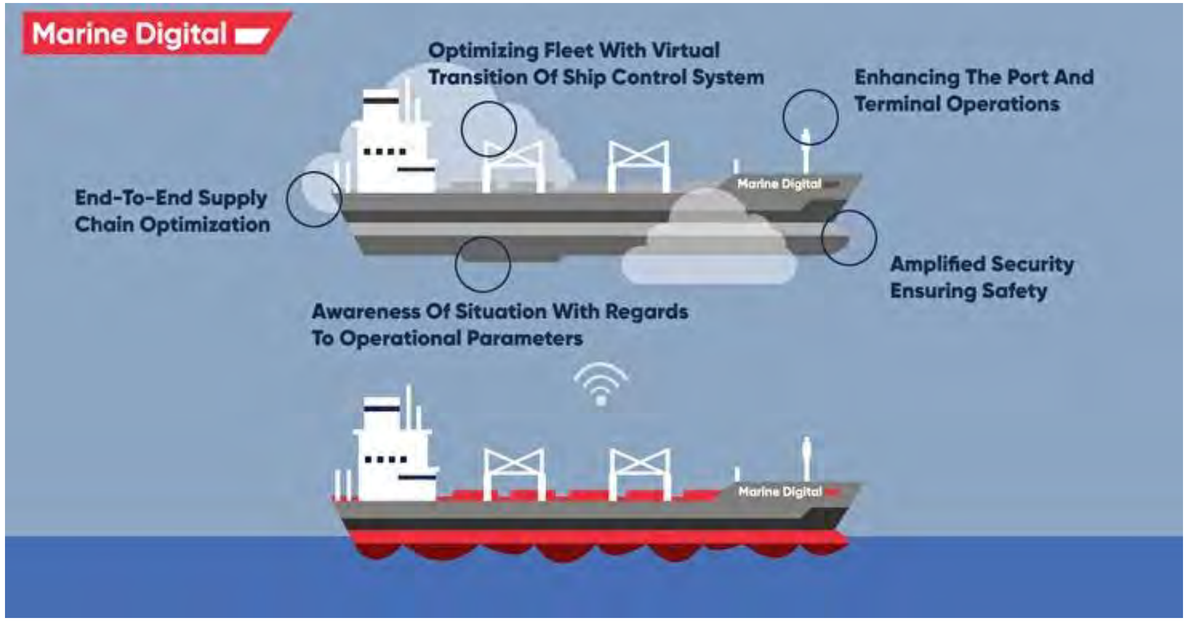


Fig. 3. Maritime transportation DTs model of relay cooperation IoT.

J. Liu, C. Li, J. Bai, Y. Luo, H. Lv and Z. Lv, "Security in IoT-Enabled Digital Twins of Maritime Transportation Systems," in IEEE Transactions on Intelligent Transportation Systems, doi: 10.1109/TITS.2021.3122566.

❑ Benefits of the Marine Digital Twin Applications

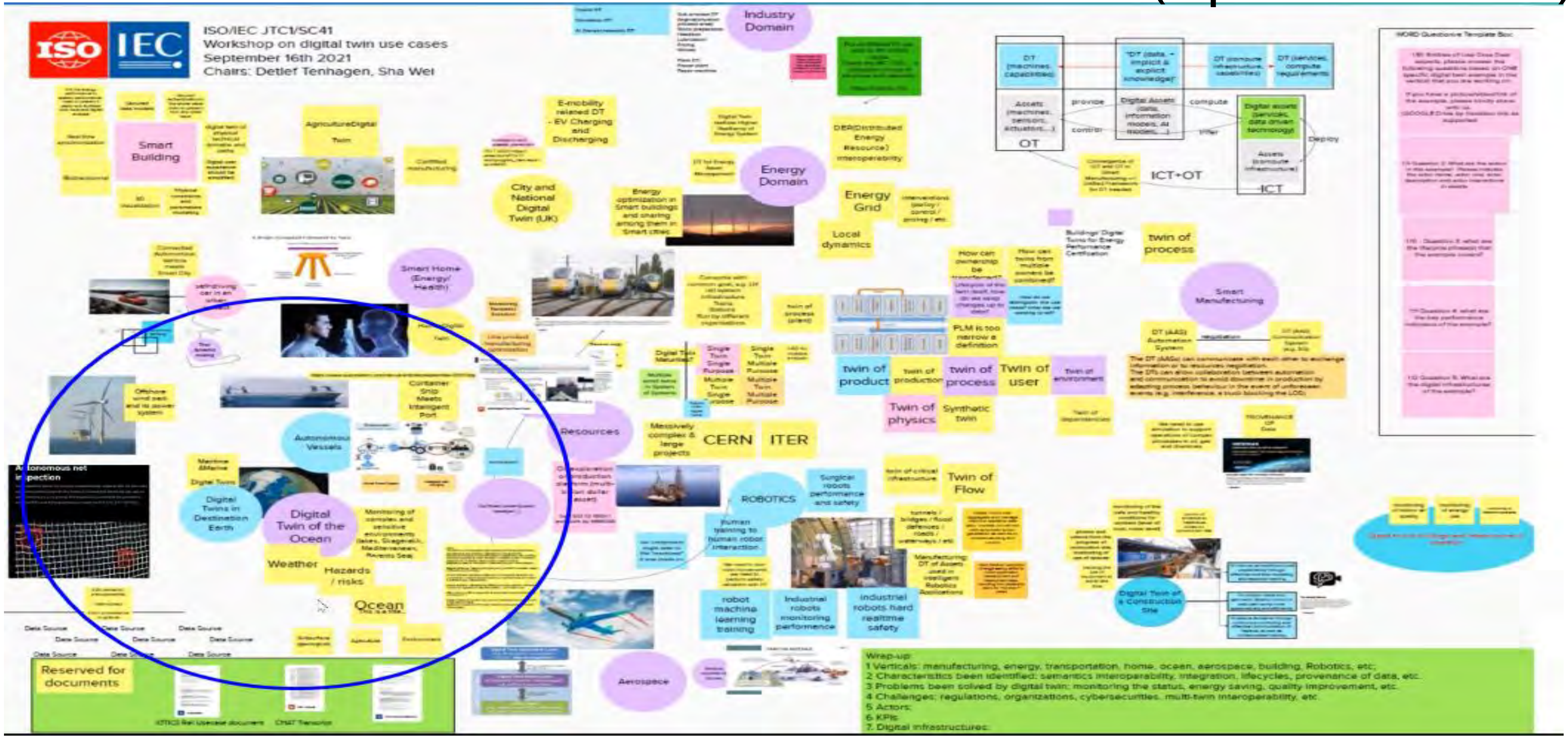
- Optimizing fleet with the virtual transition of ship control system
- Enhancing the port and terminal operations
- Awareness of situation with regards to operational parameters
- End-to-end supply chain optimization
- Amplified security ensuring safety



https://marine-digital.com/article_5benefits_of_digital_twin

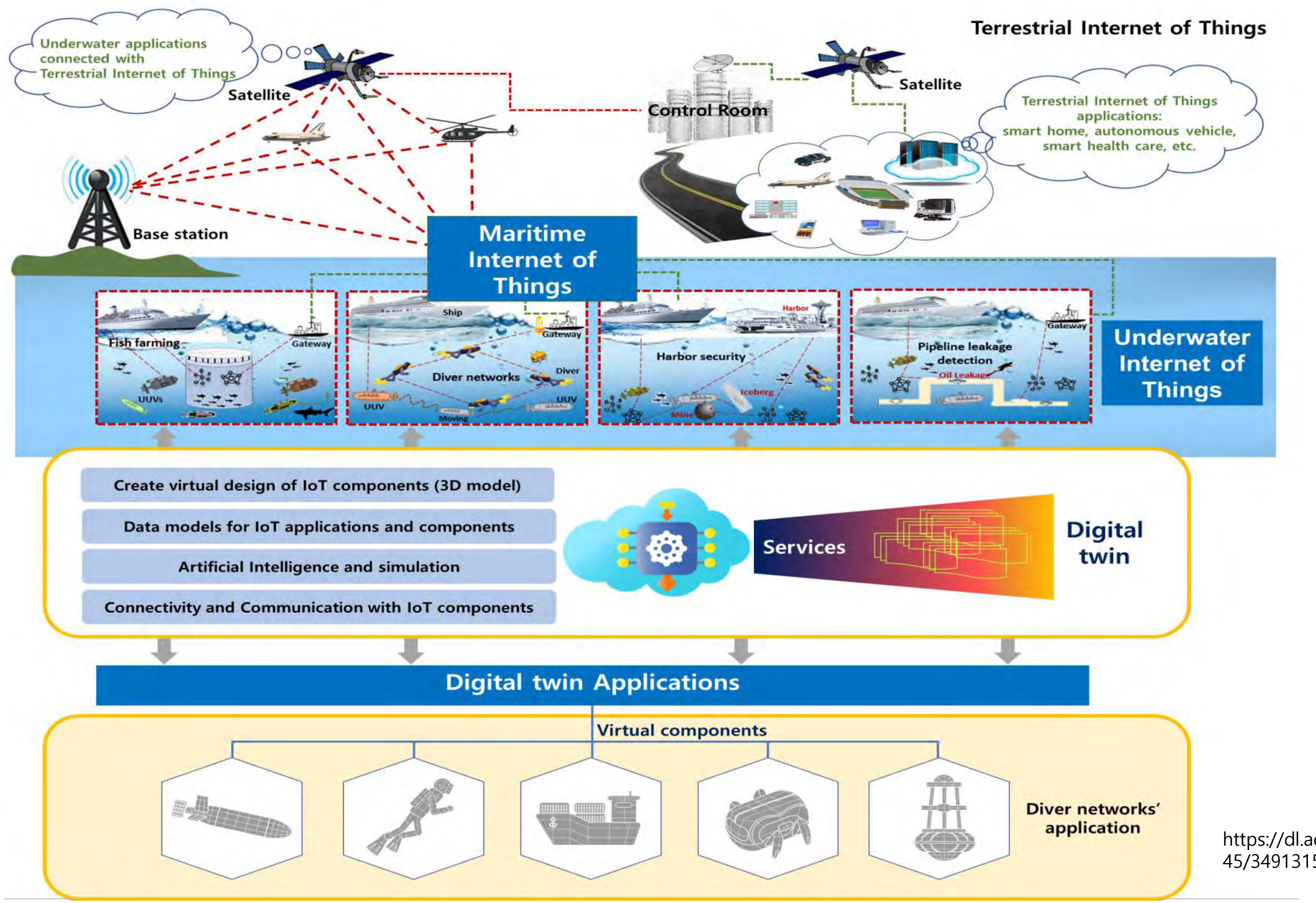
❑ From WG 6 Workshop on Digital Twin Use Cases

(September 16th 2021)



Source by Axbjorn Hovstø’s presentation material (Refer to SC41WG7N033)

2. Digital Twin Applications of the Ocean



https://dl.acm.org/doi/abs/10.1145/3491315.3491366

3. SC 41/WG 7 Standard Roadmap

Year		2021	2022	2023	2024	2025
Maritime IoT RA	SC 41		IoT RA 2nd Edition	**Maritime IoT RA 1st Edition**		
Maritime IoT Use cases	SC 41			**Maritime IoT Use cases**	**Maritime and Underwater IoT Use cases**	
Maritime Terms and Definitions	SC 41				Maritime Terms and Definitions	

Year		2021	2022	2023	2024	2025
Underwater Digital Twin Use cases	SC 41			Digital Twin Use cases	**Underwater Digital Twin Use cases**	
Maritime Digital Twin Use cases	SC 41			Digital Twin Use cases	**Maritime Digital Twin Use cases**	
Maritime and Underwater Digital Twin Use cases	SC 41				Digital Twin RA	**Maritime and Underwater Digital Twin Use cases**

INFORMATION TECHNOLOGY STANDARDS

3. SC 41/WG 7 Standard Roadmap

UWASN RA	• ISO/IEC 30140-1:2018, Information technology – Underwater acoustic sensor network (UWASN) – Part 1: Overview and requirements • ISO/IEC 30140-2:2017, Information technology – Underwater acoustic sensor network (UWASN) – Part 2: Reference architecture • ISO/IEC TR 30167:2021, Internet of Things (IoT) – Underwater communication technologies for IoT • Multi-media Multi-band based Underwater Communication Reference Architecture
UWASN Interoperability	• ISO/IEC 30140-3:2018, Information technology – Underwater acoustic sensor network (UWASN) – Part 3: Entities and interfaces • ISO/IEC 30140-4:2018, Information technology – Underwater acoustic sensor network (UWASN) – Part 4: Interoperability • [ACD] ISO/IEC 30177, Internet of Things (IoT) – Underwater network management system (U-NMS) interworking • [NP] Internet of Things (IoT) – Addressing interoperability guidelines between heterogeneous underwater sensor networks (UWASN) based on underwater delay and disruption tolerant network (U-DTN) • [NP] Internet of Things (IoT) – Addressing interoperability between IPv6-based network and UWASN • Underwater Communication Frequency Report (TR) • How can underwater communication systems be designed to effectively characterize and mitigate the risk of disturbing marine life? (TR)
UWASN Application Service	• ISO/IEC 30142:2020, Internet of Things (IoT) – Underwater acoustic sensor network (UWASN) – Network management system overview and requirements • ISO/IEC 30143:2020, Internet of Things (IoT) – Underwater acoustic sensor network (UWASN) – Application profiles • ISO/IEC 30171-1:2022, Internet of Things (IoT) – Base-station based underwater wireless acoustic network (B-UWAN) – Part 1: Overview and requirements • [FDIS] ISO/IEC 30142-2, Internet of Things (IoT) – Underwater acoustic sensor network (UWASN) – Network management system – Part 2: Underwater management information base (u-MIB) • [NP] Internet of Things (IoT) – Underwater acoustic sensor network (UWASN) – Network management system – Part 3: Underwater network element management system (UWNEMS) • B-UWAN Architecture , Functions and Procedure • Underwater network management system (U-NMS) Protocol
Underwater IoT/IoS	• Underwater IoT RA • Underwater IoT Use cases
Maritime IoT	• Maritime IoT RA • Maritime IoT Use cases
Maritime & Underwater IoT	• Maritime & Underwater IoT RA • Maritime & Underwater IoT Use cases
Underwater Digital Twin Application	• Underwater IoT Digital Twin RA • Underwater IoT Digital Twin Use cases
Maritime & Underwater Digital Twin Application	• Maritime IoT Digital Twin Use cases • Maritime and Underwater IoT Digital Twin Use cases

Maritime IoT & Digital Twin

Published On-going Important Work Future Work

4. Conclusion

❑ ISO/IEC JTC 1/SC 41/WG 7 Activities

- **Standardization for industrial and global market competitiveness is actively underway in line with the development of maritime IoT technologies.**
- **ISO/IEC JTC 1/SC 41/WG 7 has successfully led the development of international standards for the Internet of Things and digital twin applications.**

❑ Future Business Plan

- **It is expected to improve the competitiveness of the marine industry as various international institutions actively participate in international standardization activities for maritime, underwater IoT and digital twin applications.**
  - Maritime IoT applications are in the beginning, especially in supply chain and logistics, spurred by COVID-19. However, maritime industries are vast. Thus, key maritime subdomains should be selected for the WG 7 to work on.

Thank You

Digital Twins in the Energy Sector

v 1.1

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Laurent Guise
IEC System Committee Smart Energy
Joint IEC SyC SE/ISO-IEC JTC1 SC41 JWG3
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Digital Twin in the Energy Sector
The role of standardization

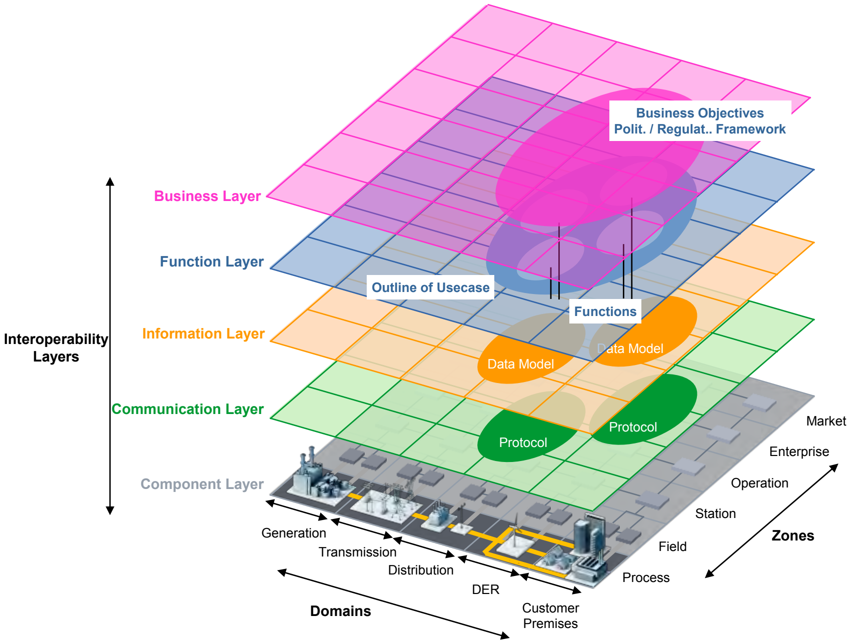
The Energy sector has already deployed for decades quite advance approaches of its digitalization by the mean of modelling and digital communication :

- Covering most of the energy market sub-domains including transmission & distribution grid operators, generation (bulk or distributed),
- Covering (mostly) the whole life cycle – from planning to maintenance
- Covering two main macro-levels :
  - Field level
  - Remote operation level

The role of standardization consists in offering standardized communication means and semantics (including behavior) to enable twins interoperation :

-> supports twins standardized interfaces, but doesn't address twins content

IoT and digital twins global framework
The Smart Grid Architecture model (SGAM)



This framework helps multiple stakeholders from different domains to depict similar "things" in a consistent way.
It may apply to functional architectures, actors and use cases, physical systems, semantic domains models and ontologies, communication networks, standards …

Let's apply it to our case !!

Source [3]

Example : digital twins are already very much present in smart energy operation systems

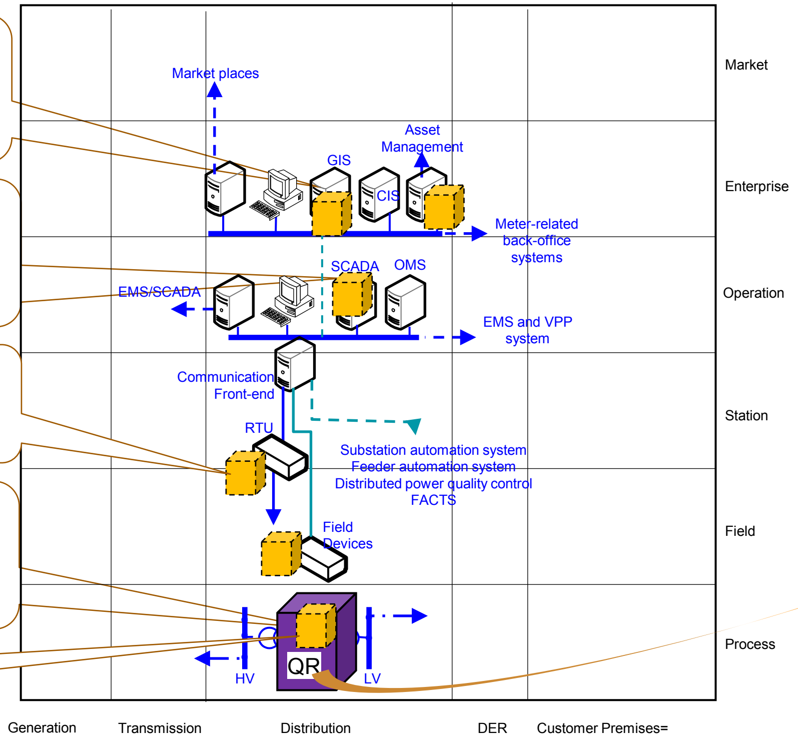
Geographical info system or Asset management system store most of the static information of the product (nameplate, ratings, settings, …) also potentially fed by condition monitoring info

The SCADA hosts twins to reflect the main properties of the product/function (static - ratings, settings- and real-time) , with possible advanced models to verify proper functioning

The station interface or controller hosts twins to reflecting the main static (ratings, settings) and real-time properties of the product and associated functions

Field device hosts twins to monitoring whether the device is running well and possibly the digital nameplate.
(If a switch is too slow to open, an alert is raised)

A twin may exist in the equipment itself by hosting its digital nameplate



Twin (virtual)

Asset (physical)

Product digital nameplates hosted remotely by the product suppliers web site

Source [1]

Digital twins are de facto present along the whole life cycle

Product/function generic characteristics model (thermal, electrical, mechanical). Possibly product simulation models

Product models and associated simulation – if any (thermal, electrical, mechanical)

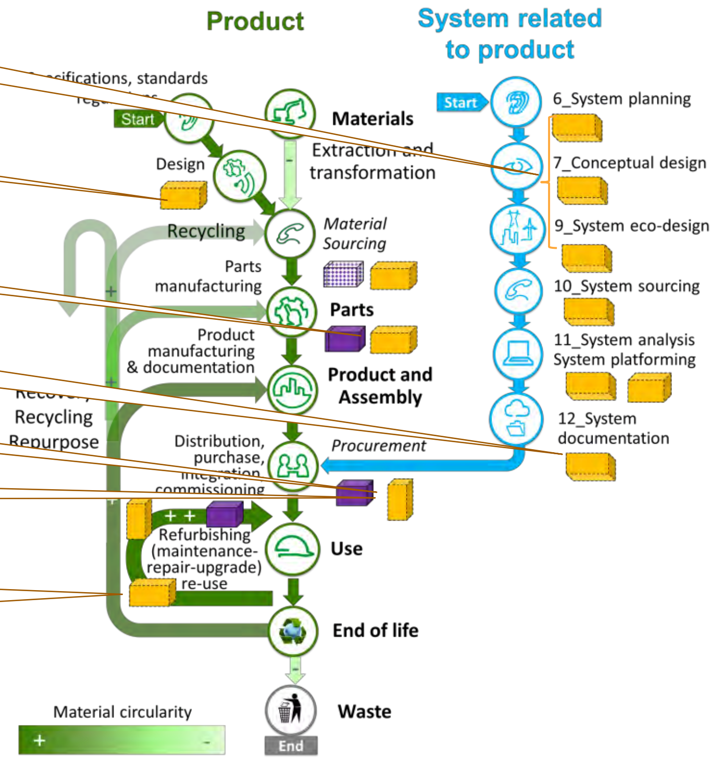
Multiple rendition digital model of product characteristics (paper, web, apps, . . .)

Product/function requirement model, to be used at all downstream phases as a reference

Twins comparison activity, between the manufacturer's and user's perspectives

Product transportation traceability model, including the change of ownership

Digital twins in all layers and all applications of the user's operation and maintenance systems to cover all usage facets



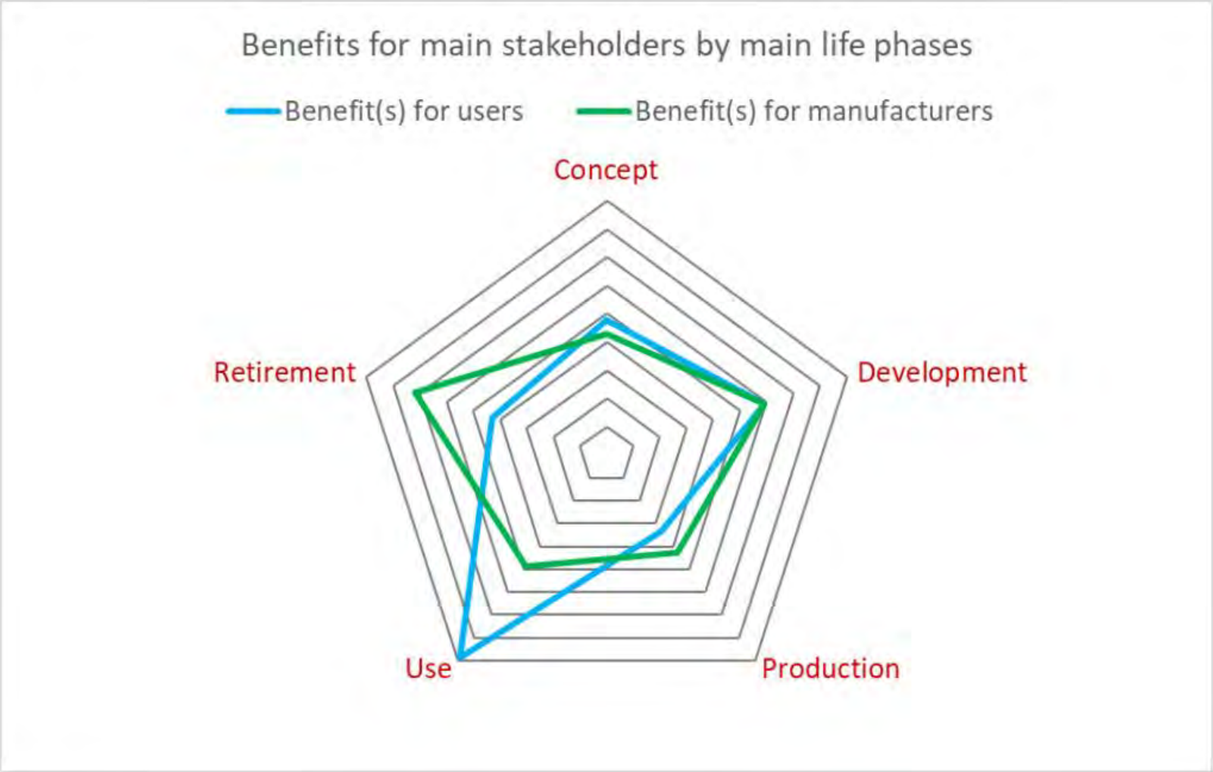
Twin (virtual)

Asset (physical)

Note : the SGAM is missing one dimension, the life cycle

Source [1]

Digital twins benefits versus life cycle



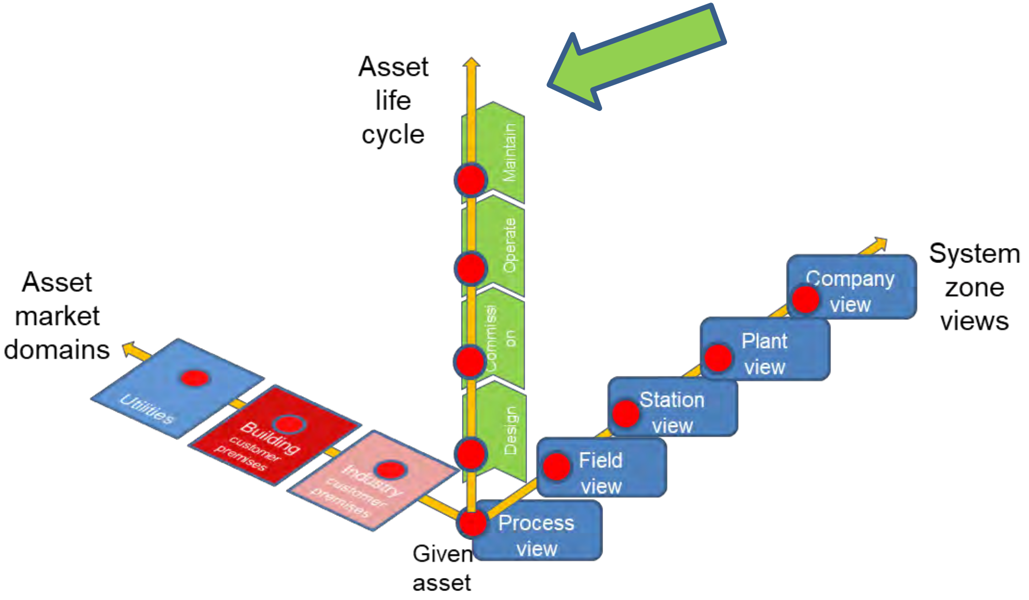
Source [2]

Multiple twins for a given asset
… and multiple semantic domains

Let's adapt the SGAM framework for the purpose of this exercise, and focus only on information models.

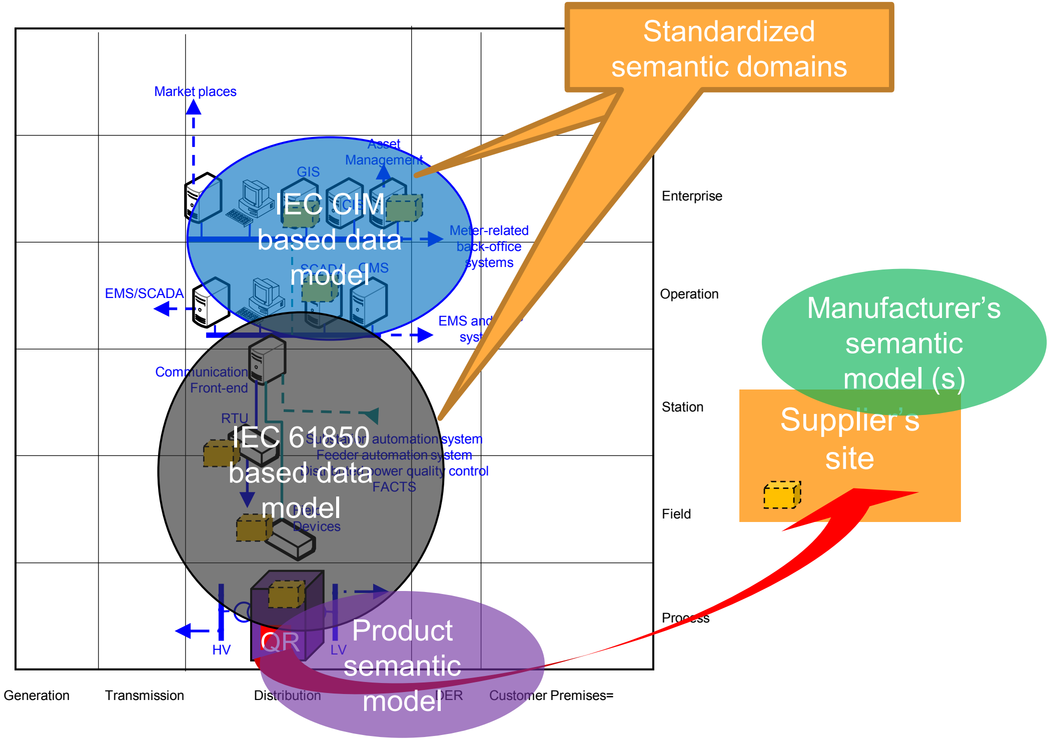
Z-axis will reflect the asset life cycle

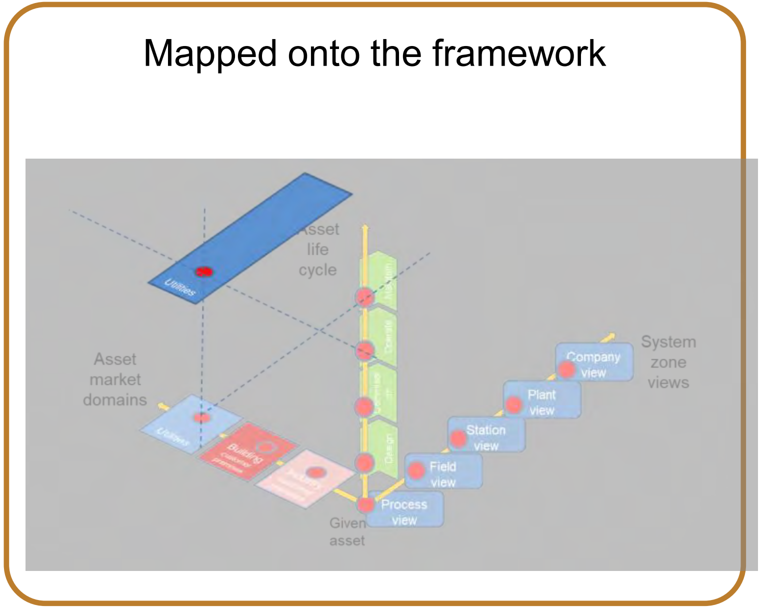
Red bullet ● reflects digital twins entry



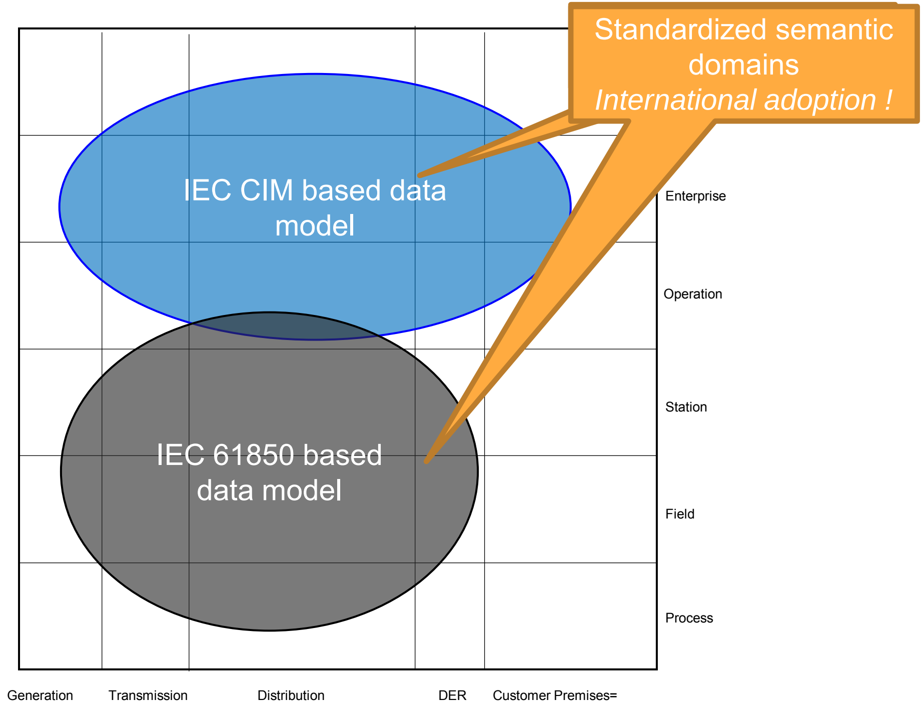
Source [1]

The standardized semantic domains used to express twins interfaces in distribution Utilities market

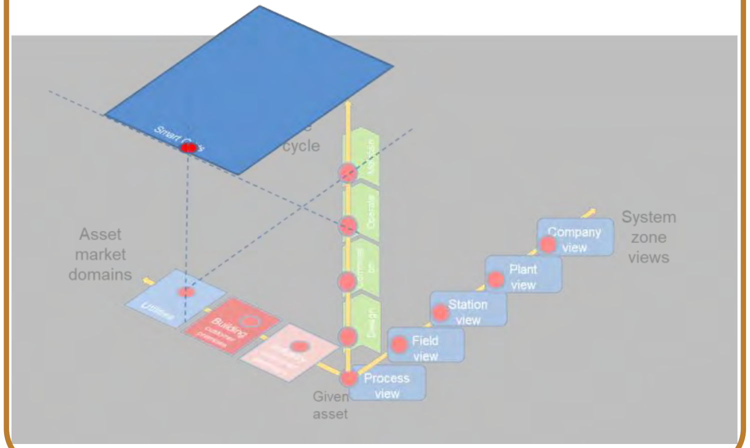




The standardized semantic domains used to express twins interfaces in Smart Grids market



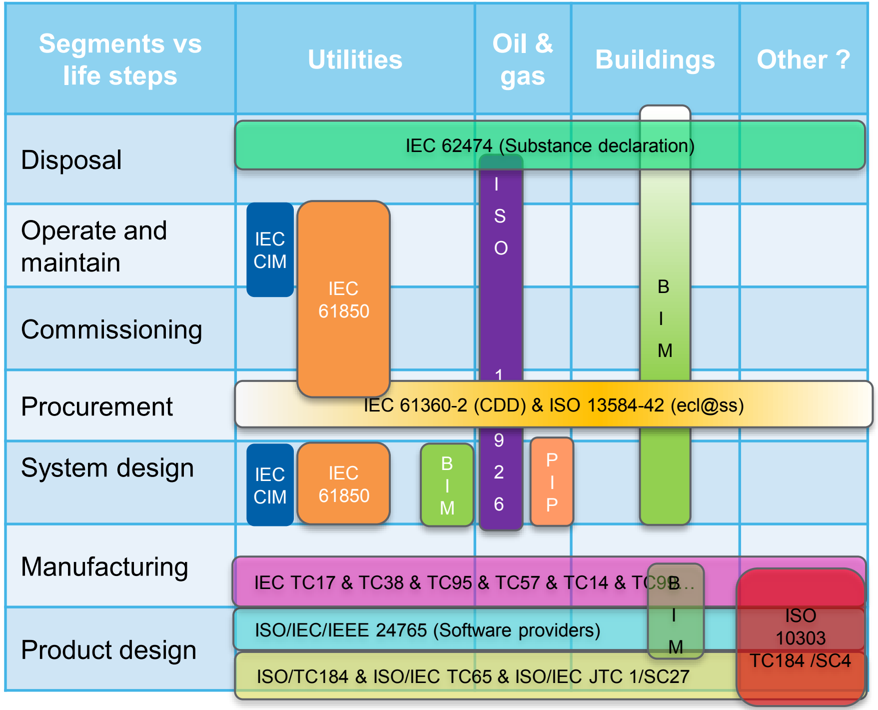
Mapped onto the framework



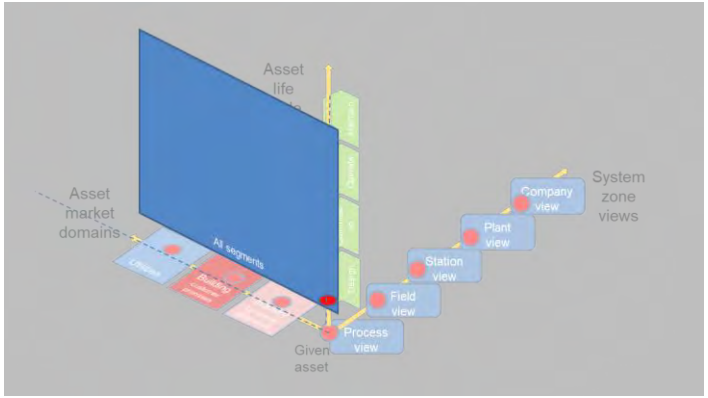
Source [4]

The standardized semantic domains used to express twins interfaces for High Voltage equipment

SC41

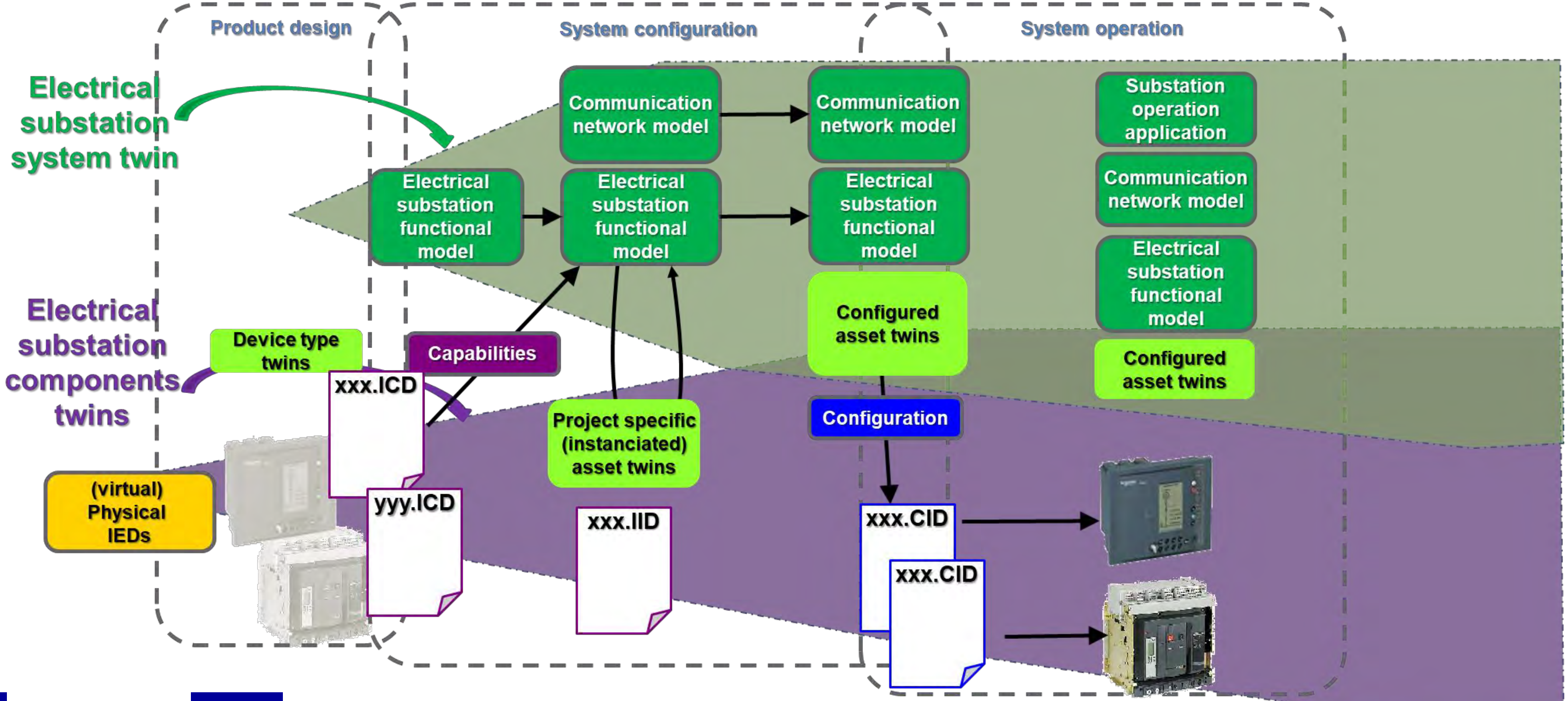


Mapped onto the framework



Source [2]

An innovative approach for composing twins !! IEC 61850



Conclusion and challenges

Digital twins semantic interoperability is a must, and this shall be observed through the prisms of

- The **life cycle** where many data for a same given asset are shared between many steps
- The **system zones** (which determine the perspective to be considered for a given asset)
- The **market context** of usages (which determines the ecosystem in which the twins will run)

Digital twins are **very much deployed and used in the Smart Energy domain**, and strong foundations already support a **good level of semantic interoperability**, across many steps of the product/system life cycle.
Innovative approaches are already addressing a specific system aspect : the **composition of twins**

However :

- most of the market drivers have been to address the (electrical) functional aspects of products and systems and less the physical ones (geometry, thermal, …)
- procurement is a crucial phase which is still (mostly) missing
- trustworthiness of digital twins is not addressed yet while essential. Cybersecurity with IEC 62443 and IEC 62351 offers first steps to secure the processes and data exchanges.

Supporting digital twins spreading is among the top 10 priorities of the IEC System Committee Smart Energy (the interest of having a joint JWG3 with SC41).

Future is critical, especially in the ability of international standardization bodies to **manage efficiently semantic interoperability**, with typically the needed level of governance. IEC SG12 (strategic group to support the digital transformation) is trying to address this issue.

Thank You!

https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/

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[1] CIRED 2021 - *How to overcome difficulties met in deploying digital twins of electrical assets over their whole life cycle? A data management perspective*. Laurent Guise, Luc Hossenlopp, Thierry Cormenier, Anne-Françoise Cutting-Decelle, Giovanna Di Marzo Serugendo, Imran Khan

[2] IEC TC17- AhG7 Report 17/1083 - *Catalogue data of high-voltage switchgear and controlgear*

[3] IEC SRD 63200 *Smart Grids architecture model*

[4] IEC TR 63097 *Smart Grids roadmap*

IoT Applications and Domain Standards

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JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Outline

1. JTC 1/SC 41/WG 5 (IoT Applications) Activity Overview

2. IoT Applications for Pandemic (with WG 5 current project)
   - Detection, Diagnosis, Contact tracking and Quarantine tracking etc.

3. IoT Applications for Environments/Climate Changes (with WG 5 current project)
   - Environment monitoring and protection etc.

4. IoT Applications for Foods (as a prospective IoT Applications area)
   - Aquaculture, Agriculture and Livestock farming etc.

5. IoT Use cases

JTC 1/SC 41/WG 5 : IoT Applications

Mission

Standardization in the area of IoT applications, Uses Cases, tools, and implementation guidance

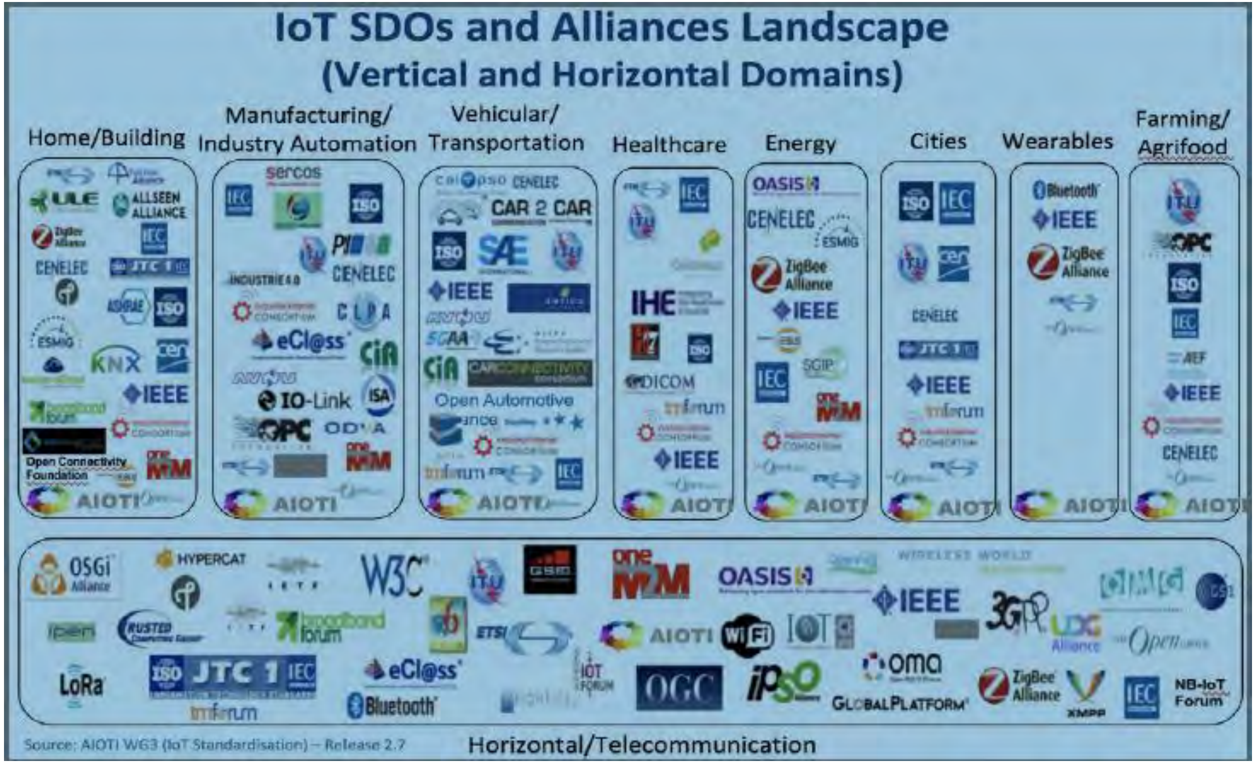
P-Members (voting)

Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, Korea, Luxembourg, Malaysia, Mexico, Netherlands, Norway, Russia, Singapore, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States of America (Total: 26)

Number of Participants : 281

Wide Range of IoT Applications

Diverse and complex SDO



Approach in WG 5 - I

Cooperation & Collaboration with Domain specific SDOs

- Liaisons
  - ISO TCs/SCs, IEC TCs/SCs, JTC 1/SCs and others

- **Incubator** for (Joint) WGs
  - JWG 17 with IEC TC 65 : System interface between industrial facilities and the smart grid
  - JWG 24 with IEC TC 57 : IIoT and digital twin applications in power systems management
  - JWG 3 with IEC SyC SE : IEC Smart Energy Roadmap
  - SC 41/WG 7 : Maritime, underwater IoT and Digital Twin applications
    (possibly to be a JWG with ISO/TC 8, IEC/TC 18, IEC/TC 80)

Approach in WG 5 - II

Cooperation & Collaboration with Domain specific SDOs

- Needs strong cooperation with SC 41/AGs :
  - AG 20 : Industrial IoT
  - AG 21 : Smart City and Utilities IoT
  - AG 25 : Use cases
  - AG 28 : LG with AI
- Every IoT Application project is recommended to describe its IoT use cases

Published standards

- **ISO/IEC TR 30166:2020** Edition 1.0 (2020-04-29) Internet of Things (IoT) - Industrial IoT
- **ISO/IEC 30162:2022** Edition 1.0 (2022-02-07) Internet of Things (IoT) - Compatibility requirements and model for devices within Industrial IoT systems
- **ISO/IEC 30163:2021** Edition 1.0 (2021-03-11) Internet of Things (IoT) - System requirements of IoT and sensor network technology-based integrated platform for chattel asset monitoring
- **ISO/IEC TR 30174:2021** Edition 1.0 (2021-11-04) Internet of Things (IoT) - Socialized IoT system resembling human social interaction dynamics

Published standards

- ISO/IEC 30144:2020 Edition 1.0 (2020-10-29) Internet of things (IoT) - Wireless sensor network system supporting electrical power substation
- ISO/IEC TR 30148:2019 Edition 1.0 (2019-10-22) Internet of things (IoT) - Application of sensor network for wireless gas meter
- ISO/IEC TR 30176:2021 Edition 1.0 (2021-11-04) Internet of Things (IoT) - Integration of IoT and DLT/blockchain: Use cases
- ISO/IEC TR 22417:2017 Edition 1.0 (2017-11-22) Internet of things (IoT) - IoT use cases (JTC 1/WG 10)

- 7 Underwater-Related Standards ….

Works in progress

- ISO/IEC FDIS 30169 : Internet of Things (IoT) – IoT Applications for Electronic Label System
- ISO/IEC CDV 30179 : Internet of Things (IoT) - Overview and general requirements of IoT system for ecological environment monitoring
- ISO/IEC WD 30180 : Internet of Things (IoT) – Functional requirements to figure out the status of self-quarantine

IoT Application for Pandemic

JTC 1/SC41 Webinar on
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2022-04-26 & 28

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qkim@etri.re.kr

Roles of IoT

IoT — **helping** →

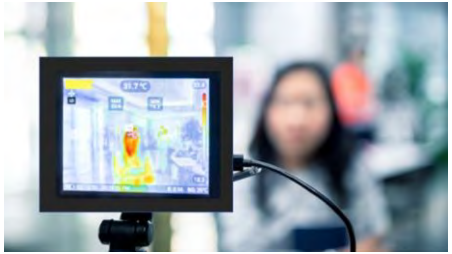
Detection and Diagnosis	Timely detection of the infection and diagnosis
Controlling the spread	Deterrence of and controlling the spreading of infection
Contact tracing	Contact tracing of infected persons
Assisting healthcare workers	Assisting healthcare workers
Supply chain	Supply of medicines and medical equipment and food items
Remote monitoring	Remote monitoring of patients
Quarantine tracking	Tracking the quarantined patients (ISO/IEC WD 30180)

Source: doi:10.1088/1757-899X/1055/1/012083

Detection and diagnosis

Timely detection of the infection and instant diagnosis

- **Goal: Early detection reduces the possibility of the spread of infectious diseases by blocking the confirmed person's contact with other people.**

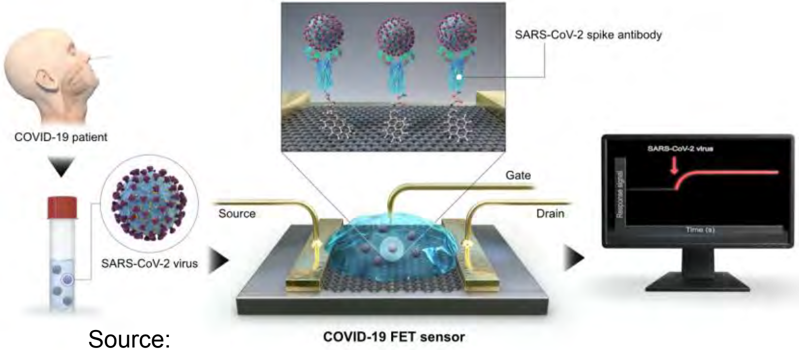


Source: FDA, & https://m.dongascience.com/news.php?idx=41238

Source: https://korean.alibaba.com/product-detail/KF150-Infrared-Thermal-Imaging-Precision-Thermometer-1600377874240.html

Source: https://ko.aliexpress.com/item/1005001764349145.html

Source: https://korean.medicalinfrared-thermometer.com/sale-12795332-quick-response-non-contact-forehead-infrared-thermometer-for-train-station.html



Source: https://www.akomnews.com/bbs/board.php?bo_table=news&wr_id=39130

Controlling the spread

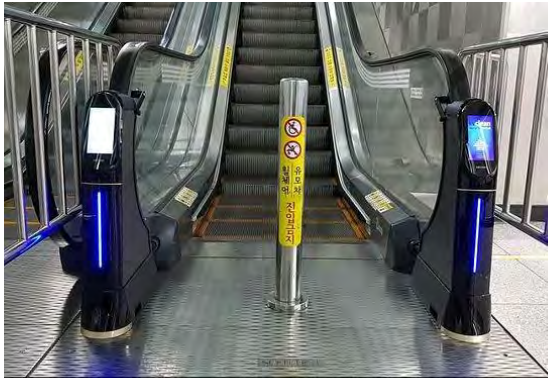
Deterrence of and controlling the spreading of infection

- **Goal: Blocking opportunities for the virus to spread.**

Source: https://www.fajournal.com/news/articleView.html?idxno=9016

Source: https://www.yna.co.kr/view/AKR20210705105000004

Source: https://kr.made-in-china.com/co_reeman/product_Intelligent-Mist-Robot-Disinfection-and-Sterilization-Machine-Medical-Spray-Sterilizer-Kill-Virus-for-Supermarket_uosymosog.html

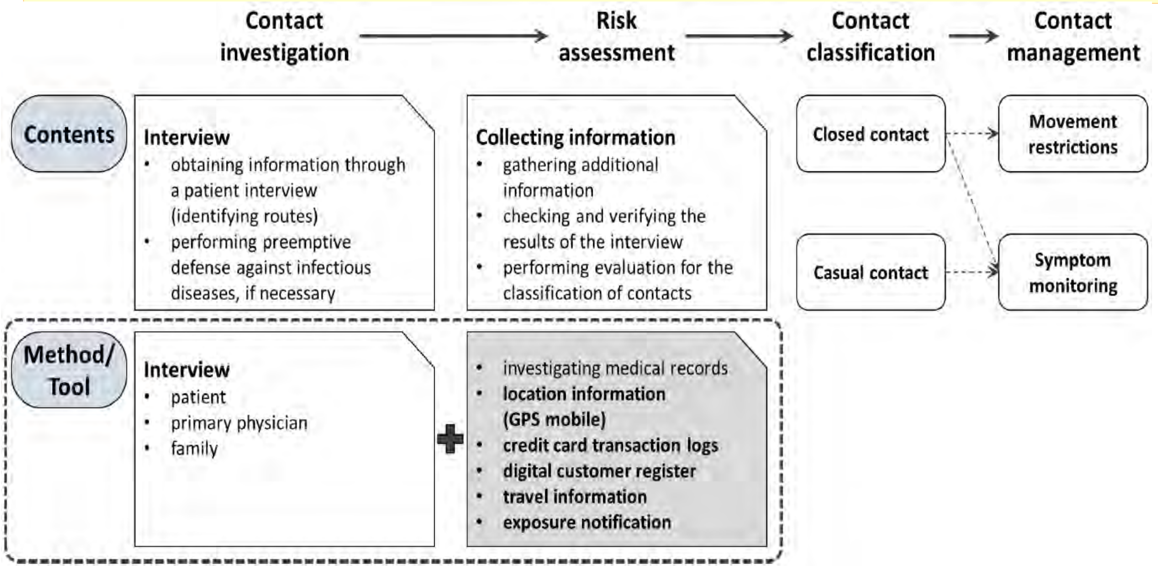


Source: https://dvdprime.com/g2/bbs/board.php?bo_table=comm&wr_id=21272606

Contact tracing

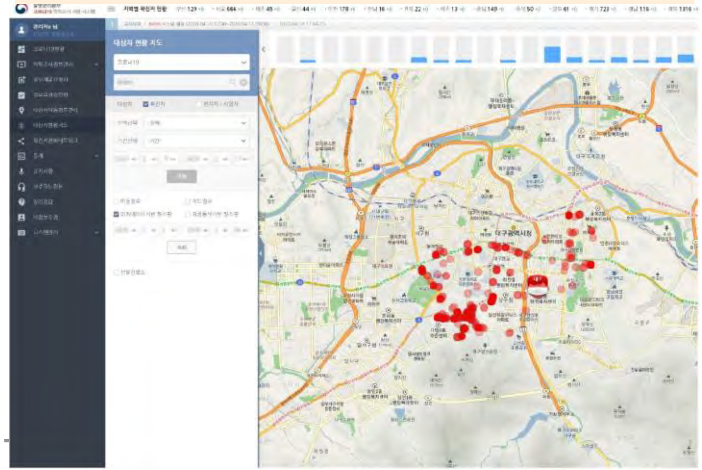
Contact tracing of infected persons

- **Goal: Identifying people (contacts) who may have been infected through exposure to a confirmed case, aiming to instruct them for their self-quarantine.**



Source: ISO/IEC 5153-3 (Proposal stage: City service platform for public health emergencies — Part 1: Contact tracing)

Korean case:
Epidemic investigation support system (EISS)

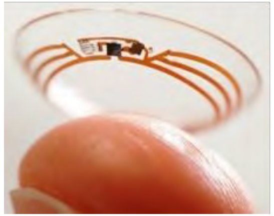


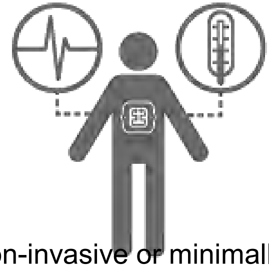
Assisting healthcare workers

Assisting healthcare workers

- **Goal: Assisting the diagnosis and treatment through monitoring the disease status and providing proper medical care without spreading the viral infection to others**

Point-of-care (POC) testing equipment





Non-invasive or minimally invasive devices

Source: https://www.pdt.com/2016-po

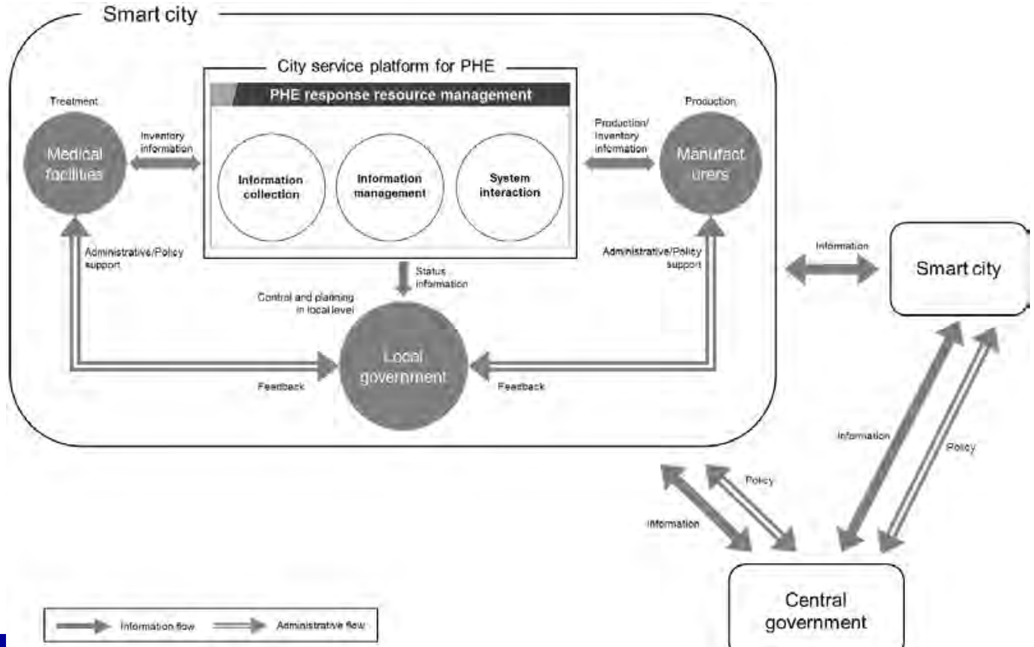
Internet of medical things use-case,
Source: https://www.scnsoft.com/services/iot/medical

INFORMATION TECHNOLOGY STANDARDS

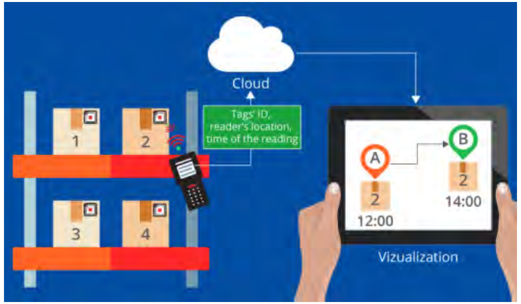
Supply chain

Supply of medicines and medical equipment and food items

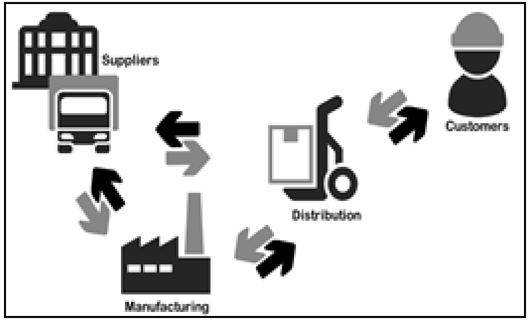
- **Goal: Managing public health resources to prevent the shortage of their supply**



Source: ISO/IEC PWI 10311-2, i.e., 5153-2 (PWI stage: City service platform for public health emergencies — Part 2: Response resource management)



Source: https://www.scnsoft.com/blog/iot-for-inventory-management



Source: https://ejournal.lucp.net/index.php/ijrtbt/article/view/749/662

Remote monitoring

Remote monitoring of patients

- **Goal: Monitoring the disease status to improve clinical decision making and to help patients improve self-management**

Source: https://thejournalofmhealth.com/the-rise-of-remote-patient-monitoring/

Source: https://www.sk-telemed.co.at/idis2go-rpm/

Source: https://kpproud-midatlantic.kaiserpermanente.org/future-medicine-remote-patient-monitoring/

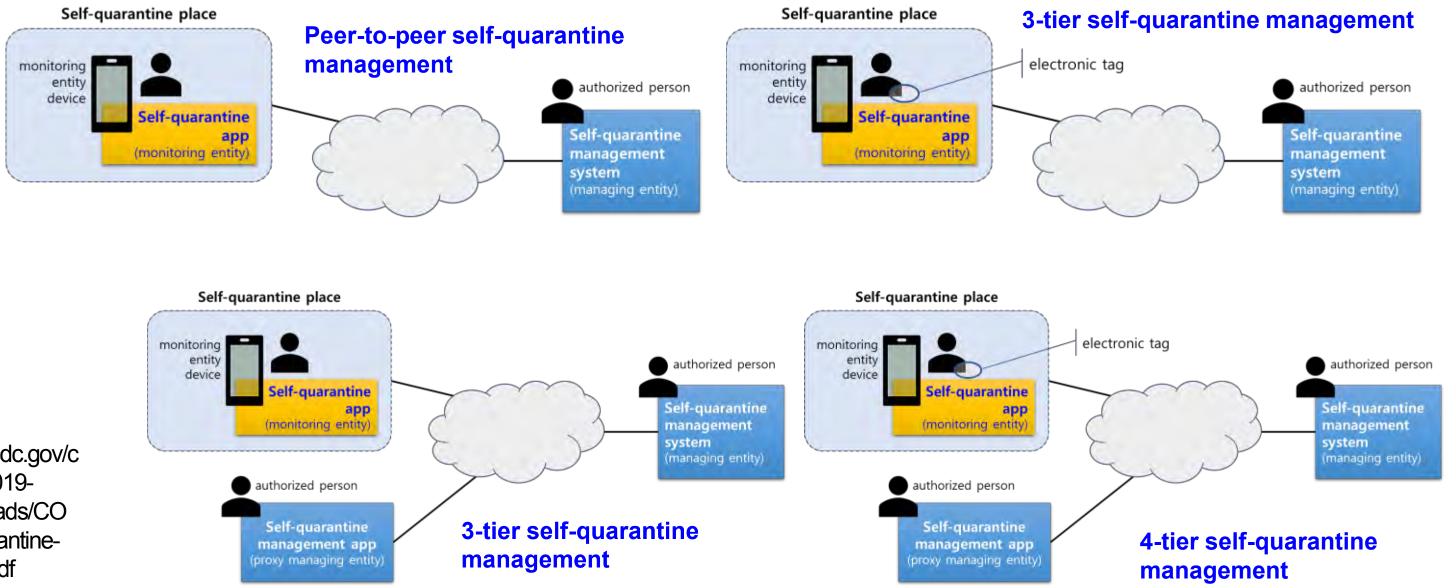
Source: https://www.accessiblehomehealthcare.com/blog/reducing-costs-with-remote-patient-monitoring

Quarantine tracking

Tracking the quarantined patients

- **Goal: Checking the quarantine status to prevent disease spread by non-cooperative quarantine persons**

Source: https://www.cdc.gov/coronavirus/2019-ncov/downloads/COVID-19-Quarantine-vs-Isolation.pdf



ISO/IEC WD 30180, Internet of things (IoT) – Functional requirements to determine the status of self-quarantine through Internet of things data interfaces

Quarantine tracking

Tracking the quarantined patients

- **Goal: Checking the quarantine status to prevent disease spread by non-cooperative quarantine persons**

ISO/IEC WD 30180, Internet of things (IoT) – Functional requirements to determine the status of self-quarantine through Internet of things data interfaces

- Liaison groups
  - JTC 1/WG 11 Smart cities
  - ISO/TC 268 Sustainable cities and communities
  - ISO/TC 215 Health informatics
  - ISO/TC 304 Healthcare organization management
  - IEC SyC Smart cities

IoT Application for Environments

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Dr. Mingjuan Wu
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Environmental issues

The environmental issues are highly related with our human beings and the nature.

Regional scale eco-environment observation networks

- GEMS (Global Environment Monitoring System)
  - Monitors the global inland freshwater quality, measures the parameters including physics and chemistry, nutrition, major ions, metal ions, organic matter, organic pollutants, microorganisms, etc.
- GTOS (Global Terrestrial Observing System)
  - Monitors, simulates, and analyzes the terrestrial ecosystem.
- ILTER (International Long Term Ecological Research)
  - Includes some national monitoring stations, and they are: US-LTER, ECN (Britain), CERN(China),etc.
- GEO.BON (Group on Earth Observations-Biodiversity Observation Network)
  - Is an observation network of plant and animal Groups.

Technologies and advantages of IoT system for eco-environment

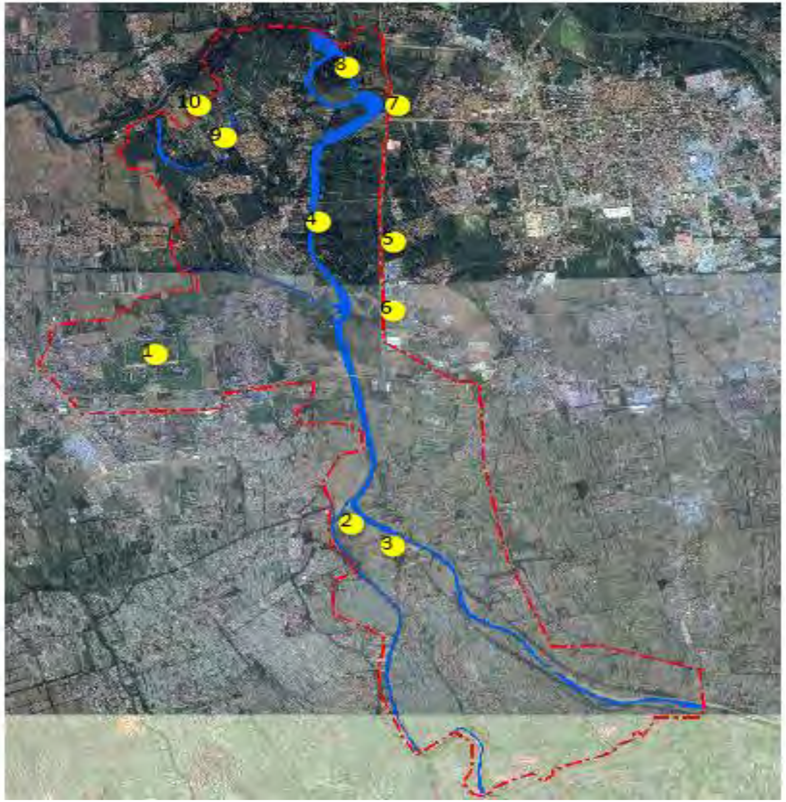
Key Technologies of IoT

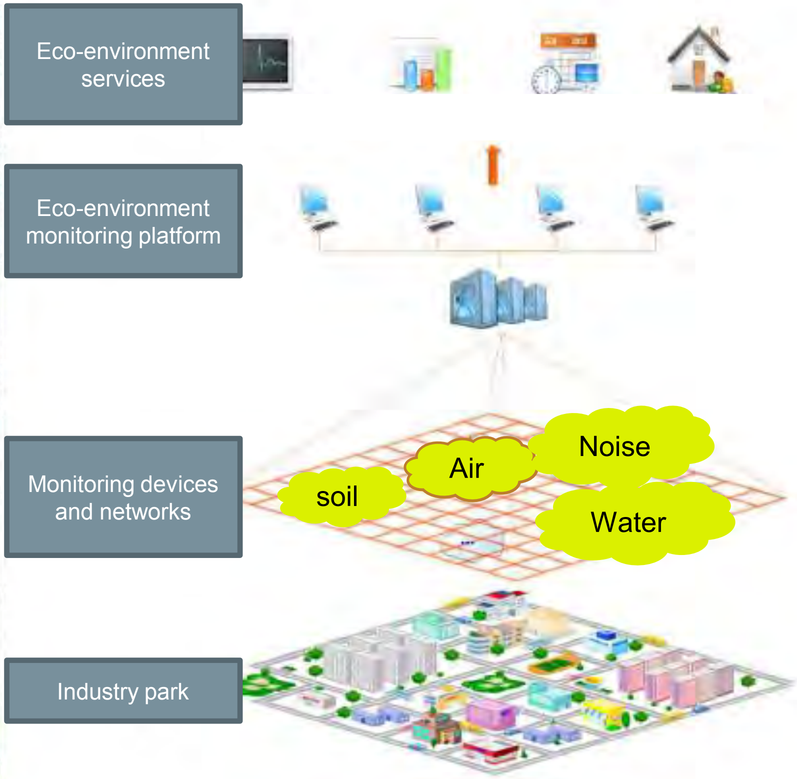
- Intelligent data processing
- Reliable data transmission and reception
- Comprehensive and accurate sensing

Using the IoT systems for ecological environment monitoring brings the following advantages:

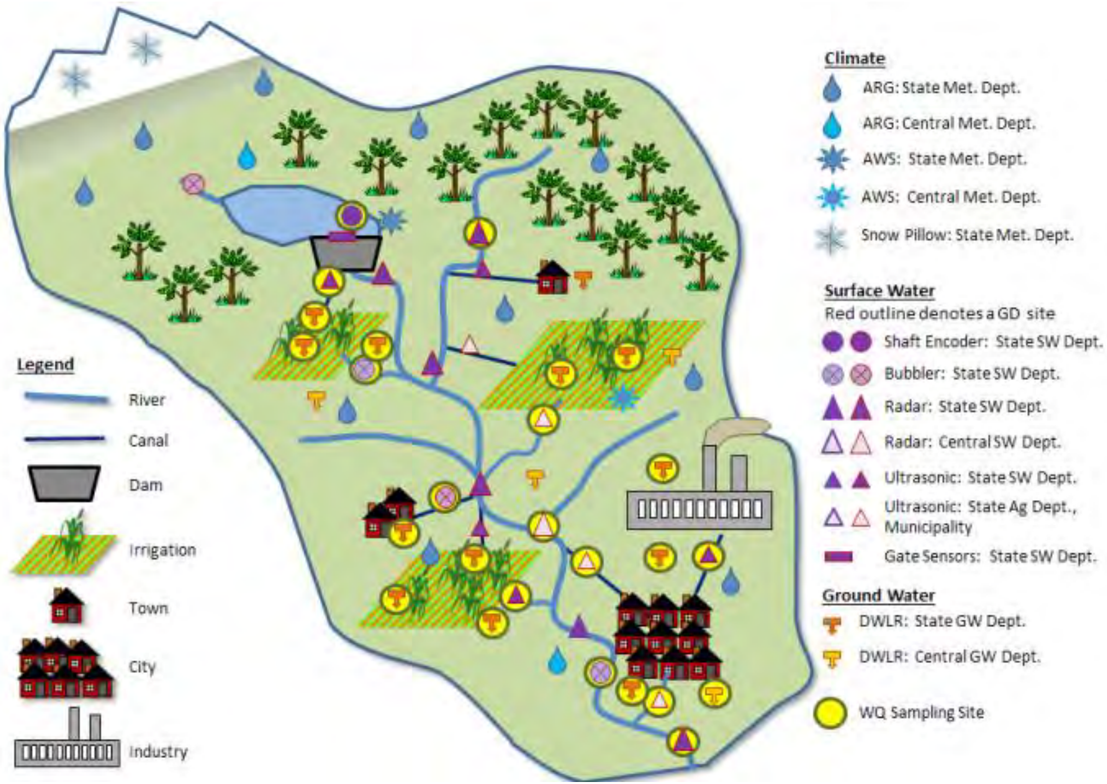
- Ensuring the real-time and dynamic observation and measurements, supporting the complexity and variability of the objects under monitoring compared with the measurements made manually and/or by legacy systems;
- Transforming from single-point monitoring station to a multi-point network application through networking and sharing of data/information;
- Taking pro-active action toward ecological events in advance rather than reacting after the events took place;
- Observing the entire ecosystem rather than geographically divided areas or regions (i.e. a single point observation) in both macro and micro perspectives; and
- Analyzing the ecological entities' relationship to ensure the sustainable development.

Use case: IoT system for eco-environment in the industrial park



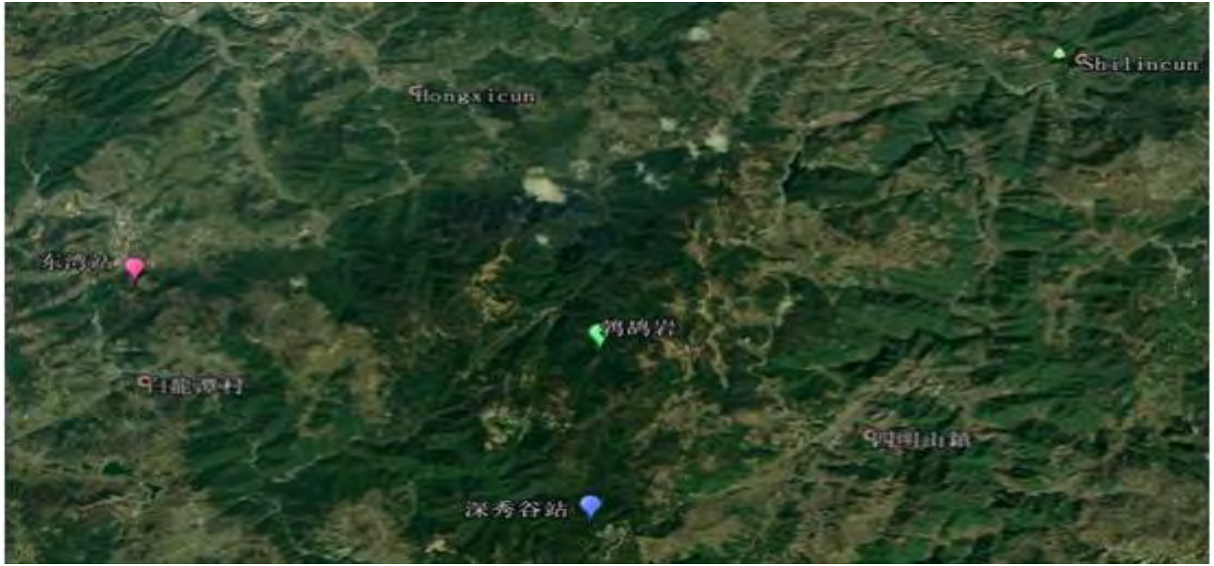


Use case: Eco-environment monitoring system for water quality



Example basin with climate, surface water and ground water monitoring networks by multi-agencies.

Use case: IoT system for eco-environment in the forest



A typical eco-environment monitoring system, consisting of sensor nodes, gateways, base stations, and service platform, is deployed to manage and maintain the forest environment and enhance travelism experience.

Standard project

- ISO/IEC CDV 30179 specifies the system overview and general requirements of IoT system for EEM.
  - The system overview of the IoT-based ecological environment monitoring (EEM) is described according to the Domain-based IoT Reference Model which is defined in ISO/IEC 30141.
  - The general requirements include functional requirements, security requirements, and performance requirements of the IoT system for EEM.
  - The project will bring benefits of full obtaining and utilization of observation data from eco-environment, and improving the interoperability of monitoring subsystem for unified environment management.
- Cooperation and collabration: ISO TC 268 (sustainable cites and communities) and JTC 1/SC 35 (User interface).
- Possible future works: focusing on the enviroment monitoring subsystem on specific domains.

IoT Use Cases

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Dr. Kate Grant
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IoT Use cases

- IEC is now developing a use case methodology in IEC SMB SG 12 *(Strategic Group 12, Digital Transformation and Systems Approach)*
- More and more standardization technical entities are using Use Cases to identify standardization requirements
- IEC are encouraging the use of a standard use case template through their work on the Smart Standards Concept
- IoT Use Cases describe specific use cases and implementations to improve the general understanding of the application and context of use of IoT
- A first TR was developed in JTC 1 WG10 (the predecessor to JTC 1 SC41) and this group collected use cases from experts and encouraged the use of a common template
- JTC 1 SC41 WG5 is now developing a number of IoT application standards

IoT Use cases

- IEC SyC-AAL (Systems Committee for Active Assisted Living) developed a template based on that used in Smart Energy. However it was clear that AAL applications and use cases differed from those in Smart Energy because they involved stakeholders including end users, home networks, telehealth providers and carers and needed additional consideration of requirements for horizontal aspects such as data security, data privacy and ethical considerations.
- IEC SyC-AAL are progressing an amendment to TS 63134 which provides an amended use case template and covers Use Case Categories
    - (Self-)management of daily life activities at home
    - Health & wellness
    - Mobility
    - Social interaction
    - Prevention and management of chronic long-term conditions

IoT Use Case Methodology

Application Systems study

- General study of IoT applications
- Identify sub-systems
- Identify basic stakeholder needs
- Fill out template

User Stories

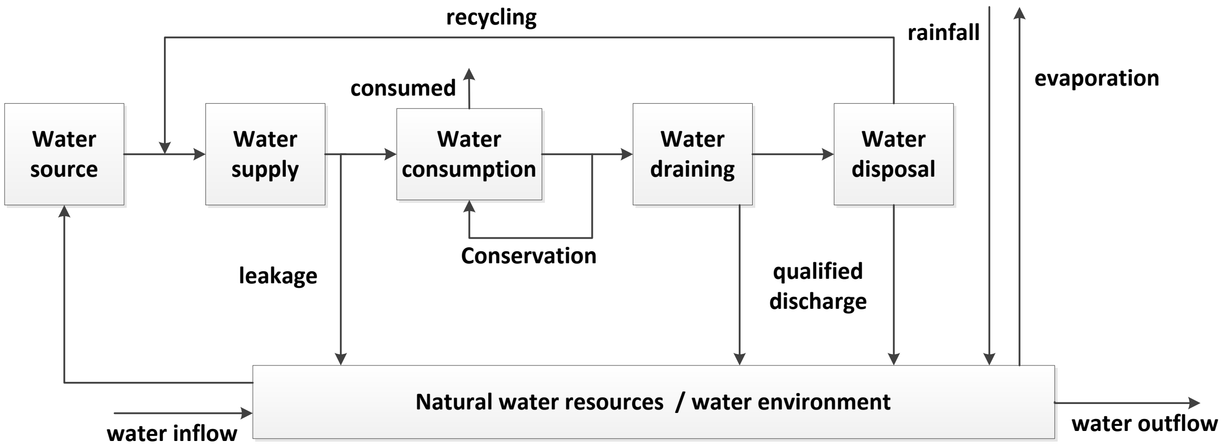
- From user stories break down stakeholder needs based on analysis of sub-systems and application areas
- Develop detailed use cases using the IEC Smart use case template

Use Case analysis

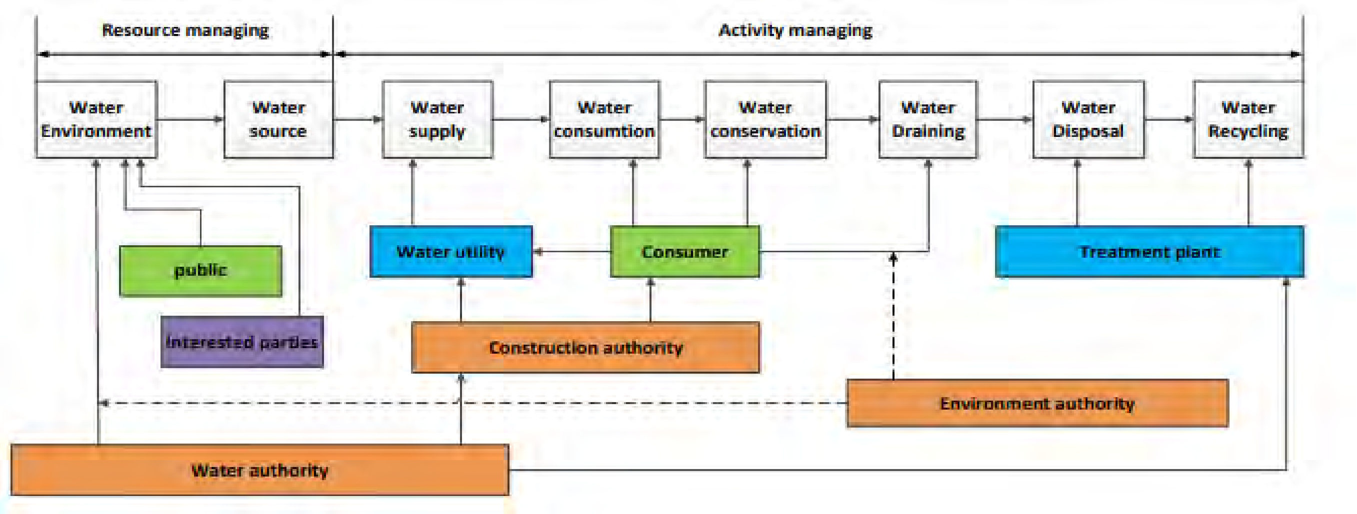
- Analyse use cases to identify sets of common requirements, actors and interactions etc.
- Use the common features to scope out a family of IoT application standards

IoT Use cases

- WG2 of IEC SyC Smart Cities are identifying the key aspects of a Smart City, collecting and analysing use cases, electrotechnical aspect of smart cities simulation, road test standards in real cities. These all involve IoT applications. They have a number of SRDs where Part 1 is the high level analysis and Part 2 is the use case analysis; eg
- **IEC SRD 63301-1 ED1** **and** **IEC SRD 63301-2 ED1** Water systems in Smart Cities



IoT Use cases



Stakeholders in the application scenario can be identified and the high level use case can be broken down into specialised use cases such as water quality monitoring, data acquisition, processing and application.

Prospective New Application Areas for SC 41 / WG 5

Smart Fish Farming and Recommended Areas

JTC 1/SC41 Webinar on
IoT and Digital Twin Standardization
2022-04-26 & 28

Dr. Howard CHOE
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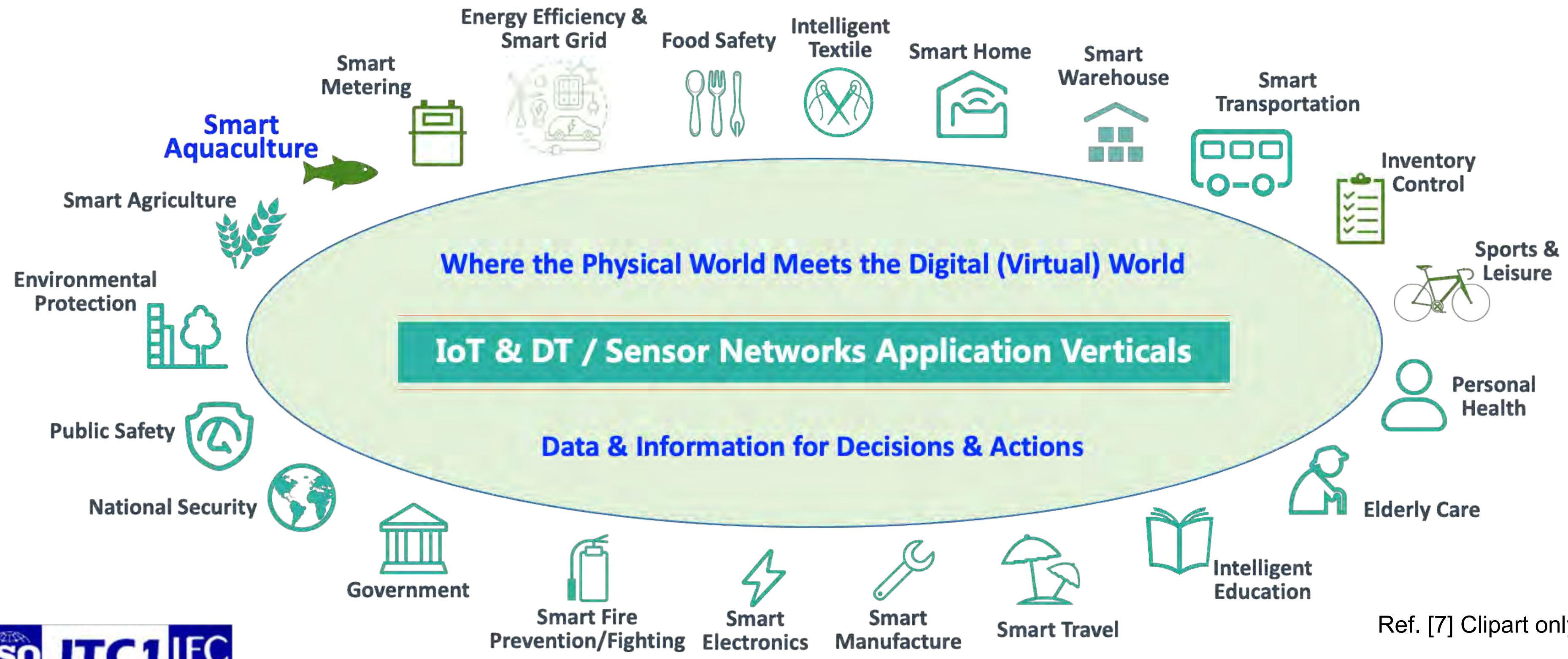
IoT & DT Application Areas (Vertical Examples)



Ref. [7] Clipart only

Global Fish Farming Market

- Global Fish Farming Market Size
  - ▷ 2019 – $285.36 Billion
  - ▷ 2027 – Expected to reach $378 Billion
  - ▷ CAGR = 5.8% (2021 to 2027)
- Asia-Pacific held a leading position in the global market in 2019
  - ▷ Expected to maintain its dominance in the future.
- Fish Farming Market Segments (environment types)
  - ▷ Marine Water
  - ▷ Fresh Water
  - ▷ Brackish Water
- Fresh water segment has been the fastest growing industry.

Ref. [3]

Aquaculture: Smart Fish Farming

- Aquaculture
  - ▷ Breeding, rearing, and harvesting of animal and plants in both fresh and saltwater environments [1].
- The Needs:
  - ▷ The fish farming industry needs instruments that can monitor in real-time fish health and welfare objectively, without harming the fish or interfering with the daily management [2].
- IoT Technologies in Aquaculture of Fish Farming [2] → Smart Fish Farming
  - ▷ Revolutionize fish farming process using sensor networks to measure the status such as:
    - pH, temperature, oxygen level, salinity, pressure, contaminants, and other parameters.
  - ▷ Develop sustainable and resilient aquaculture systems.
  - ▷ Maintain healthy aquatic ecosystems.
  - ▷ Strengthen capacity for adaptation to surrounding climate change, especially outdoor farming.
- Automated Fish Farm Management
  - ▷ Monitor and control fish farm's status in real-time, 24/7, easily and remotely;
  - ▷ Save time and operational costs; and
  - ▷ Ensure profitability.

Aquaculture Legislation and Regulation

- Aquaculture, especially fish farming, is rapidly growing, which causes regulatory challenges, resulting in:
  - ▷ Increased risk of the industry becoming unregulated;
  - ▷ Falling short of stakeholder expectations due to lack of aquaculture legislation and regulations; and
  - ▷ Negative impacts on the environment and societies do occur.
- Well-designed legislation and proper regulation:
  - ▷ Comes with investment costs;
  - ▷ Benefits aquaculture industries; and
  - ▷ Creates a level playing field between business actors.

Proper and beneficial regulations must be based on well-established and industry-accepted standards.

Ref. [4]

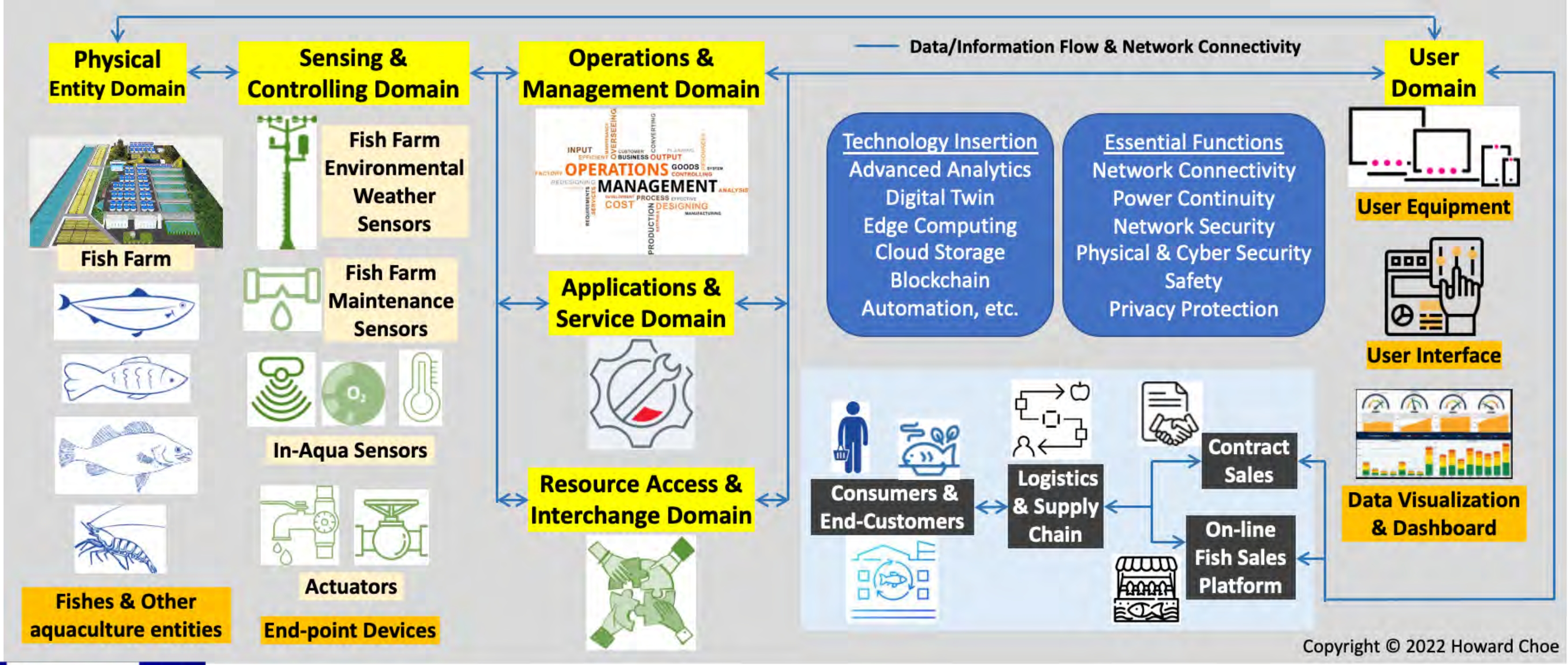
Status of Standardization in Fish Farming

- ISO/TC 234 – Fisheries and aquaculture [5]
  - ▷ Ten (10) published standards and one (1) under development:
    - Traceability of finfish, crustacean, molluscan products;
    - Environmental monitoring of the impacts from marine finfish farms; and
    - Marine finfish farm; Carbon footprint, etc.
  - ▷ Already liaised with ISO/IEC JTC 1 / SC 41
- Aquaculture Stewardship Council [6]
  - ▷ Certifies aquaculture products.
  - ▷ Develops and manages standards – The requirements covering the potential impact of aquaculture including:
    - Water quality, feed, disease prevention, animal welfare, fair treatment and pay of workers, etc.
  - ▷ Has its regional presence in:
    - Australia, Belgium, Brazil, China, France, Germany, Austria, Switzerland, Japan, Netherlands, north America, Spain, and Sweden; and international chapter covering other regions.

No Smart Fish Farming International or Regional Standard Seems to Exist.

Smart Fish Farming
High-Level System Architecture

[7] Clipart only



Smart Fish Farming
Potential Standardization Areas

- General requirements and specifications.
- Reference architecture.
- Fish farm monitoring – fish health, water condition, maintenance, environment, etc.
- Fish farm automation – Intelligent feeding, biomass determination, etc.
- Fish farm sensing requirements and technologies.
- Fish farm surrounding development.
- Different types of applications and services with data analytics.
- Logistics and supply chain associated with fish farming.
- Fish farming business model.

Smart Fish Farming
Standard Development in JTC 1 / SC 41 / WG 5

- Dr. Jie SHEN of CeleFish, LLC. (QingYuTang) in collaboration with Dr. Howard CHOE plans to submit a New Work Item Proposal (NWIP) on Smart Fish Farming.
  - ▷ The NWIP topic area(s) will be selected from the “Potential Standardization Areas” in Chart #8.
  - ▷ The fish farming-related standards are expected to be multi-part international standards.
  - ▷ Informative presentation is planned in SC 41 / WG 5 Meeting during May 30 - June 10, 2022 (with NWIP in NWIP in September 2022 with project starting in December 2022).

Standardization in SC 41 / WG 5
Recommended Application Areas

- SC 41 / WG 5 seeks International Standard (IS) NWIPs in food production areas with IoT technologies:
  - ▷ Agriculture: Arable farming (crops – grains, fruits, vegetables, etc.) → Crop cultivation & production
  - ▷ Agriculture: Pastoral farming or livestock farming (animals) → Livestock rearing & production
  - ▷ Aquaculture
- SC 41 / WG 5 also seeks NWIPs in the IoT application areas not yet introduced topics in SC 41.

SC 41 / WG 5 Seeks NWIPs in Food Cultivation and Production Standardization Areas; and Application Topics Not Yet Introduced in SC 41.

References

1. https://www.the-iot-marketplace.com/solutions/fish-farming
2. https://futureeuaqua.eu/index.php/2021/02/24/how-can-the-internet-of-things-iot-enhance-fish-health-and-welfare/
3. https://www.globenewswire.com/news-release/2021/01/13/2158043/0/en/Global-Fish-Farming-Market-to-Reach-376-48-billion-by-2025-AMR.html
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5. https://www.iso.org/committee/541071.html
6. https://www.asc-aqua.org
7. The clipart icons used in Charts #2 and #7 in this presentation are from Google image search, free download, free trial, etc., from various clipart websites or other websites and from Dr. Jie Shen's "Study on the Integration IoT & Blockchain," May 2018.

Discussion

https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/