



# Industrial Internet Reference Architecture

**Shi-Wan Lin**

CEO & Co-Founder  
Thingswise, LLC

Co-Chair, Architecture Task Group & Technology Working Group, IIC





# Industrial Internet Reference Architecture (IIRA)

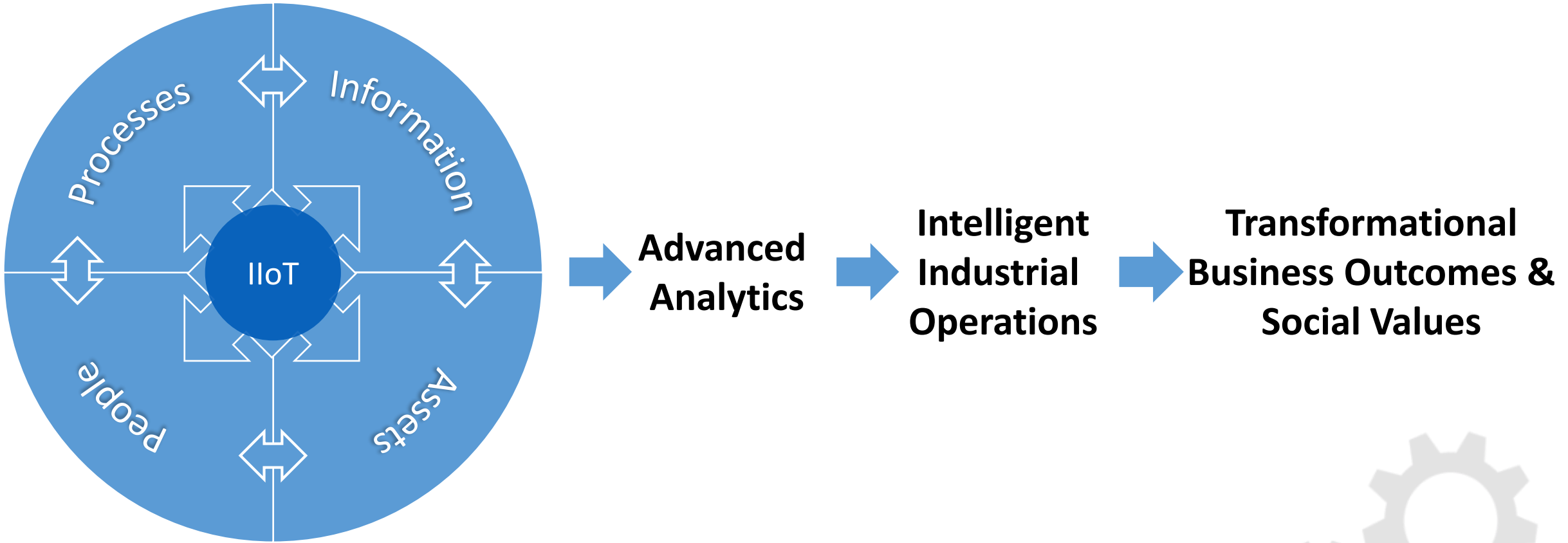
---

- IIoT: broad applicability & impact with complexity & diversity
- IIoT: common technical challenges
- IIRA: a common architecture template & methodology for meeting these challenges
- IIRA: a foundation for common building blocks, sharing know-how, & reusable technologies within & across industries
- IIRA & IISF: for building safe, secure & reliable IIoT systems with reduced effort & risks, lower costs, & shorter time to value



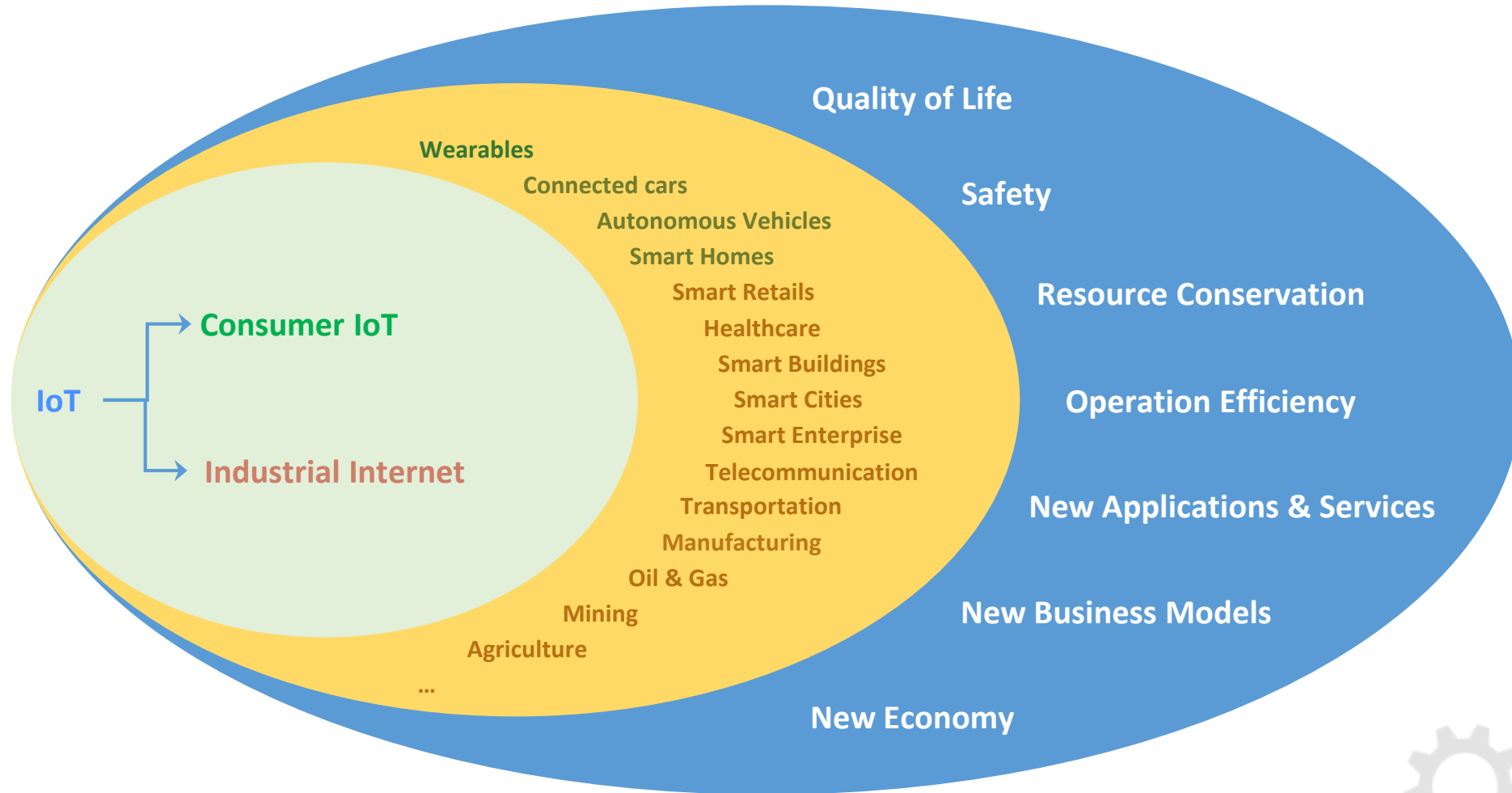


# IloT - A Simple Idea & Common Objectives





# IIoT - Broad Applicability with Complexity & Diversity





# IIoT – Common Technical Challenges



How to solve these shared challenges?





# IIoT - Common Solutions to Shared Challenges?

Industrial Systems: large-scale, heterogeneous, distributed systems with multi-vendor building-blocks...

- Are there shared system requirements & characteristics, architectural concerns & patterns?
- Can these be abstracted & generalized into a common architectural description?

Usecases across industries + Technology outlooks



Reference Architecture: Architecture template & methodology



Applications within & across industries





# IIoT - Reference Architecture - the Foundation

- Common architecture requirements, characteristics, patterns within & across industries
- Common architecture concepts & vocabulary for consistent communication & design
- Foundation for identifying interoperability requirements & developing standards
- Enable & spur innovation in an open ecosystem



For vendors to build interoperable, reusable market-fitting system building blocks



For implementers: a sound starting point for design & availability of off-the-shelf building blocks

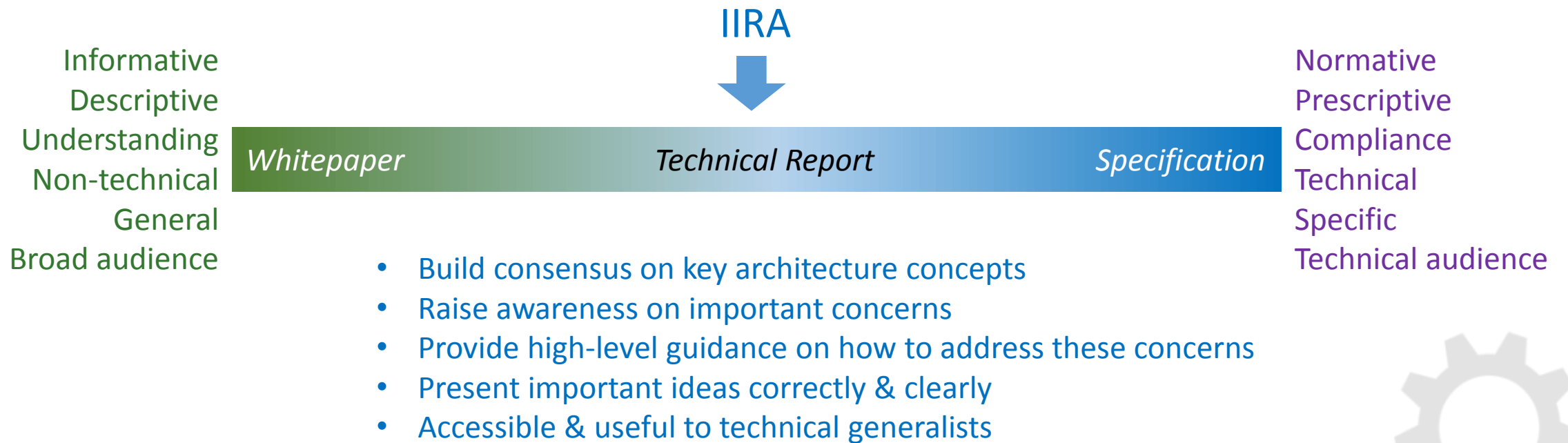


Common building blocks, sharing know-how & reusable technologies within & across industries for building safe, secure & reliable IIoT systems at reduced effort & risks, lower costs & shorter time to value



# IIRA - Technical Report

The IIRA is a standards-based architectural template & methodology enabling Industrial Internet of Things system architects to design their own systems based on a common framework & concepts.







# IIRA v1.8

---

- Reflect new technologies, concepts & applications
- Represent the latest thinking of IIC/IIoT community
- Clarify existing concepts & models
- Provide practical & implementable deliverables to the community





# IIRA - Targeted Audience

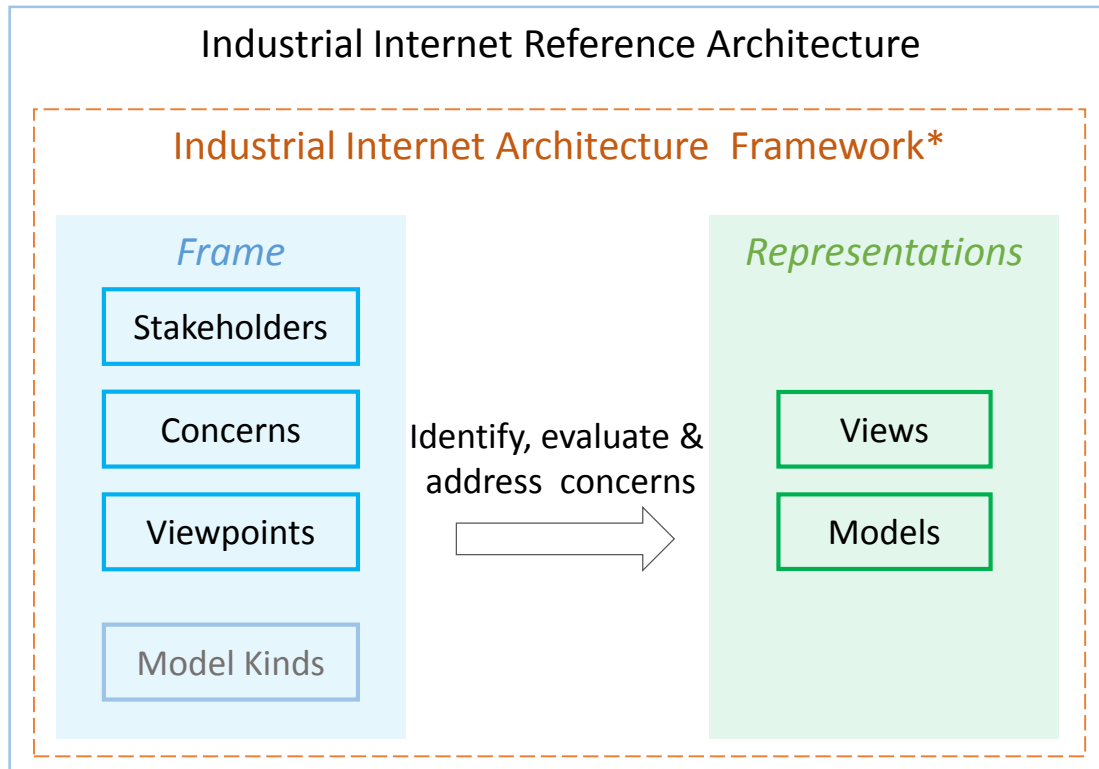
---

- IIoT system & component architects who design IIoT systems & system components, technologies & solutions within the vendors & implementers communities.
- Business decision-makers, plant managers, IT/OT managers & others who want to better understand how to drive IIoT system development from business perspectives; how the convergence of Operational Technology (OT) & Information Technology (IT) is an important part of achieving the promised benefits of IIoT

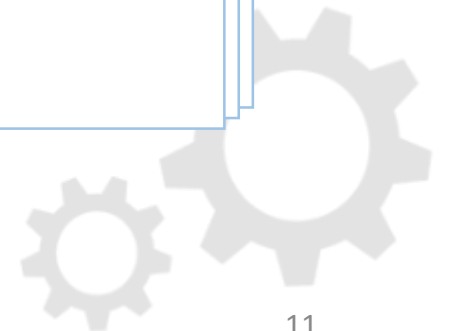
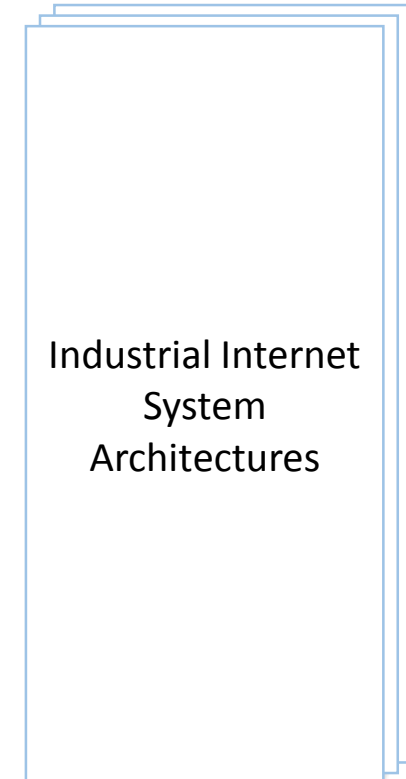
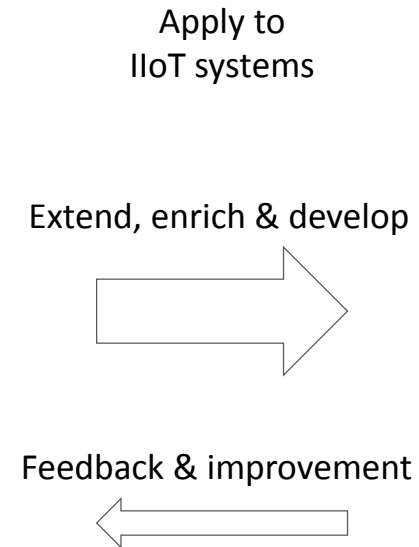




# IIRA – Standards-based Open Architecture Template & Methodology

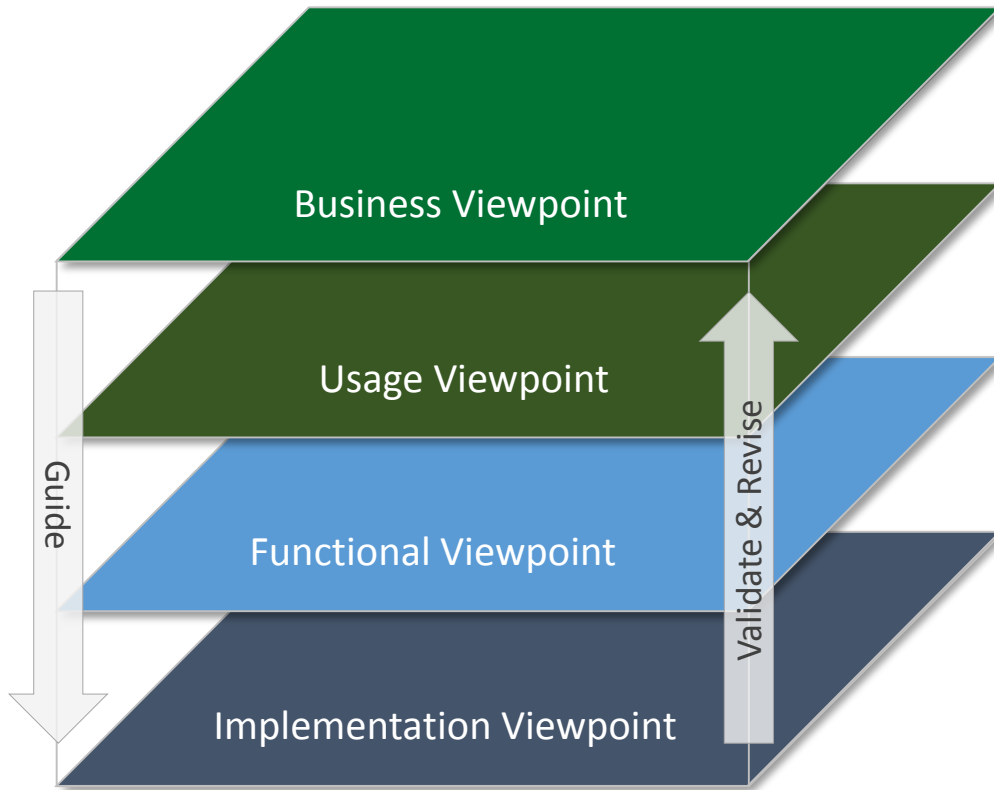


\* Based on ISO/IEC/IEEE 42010:2011 - Architecture Description





# IIRA – Business Value Driven Methodology



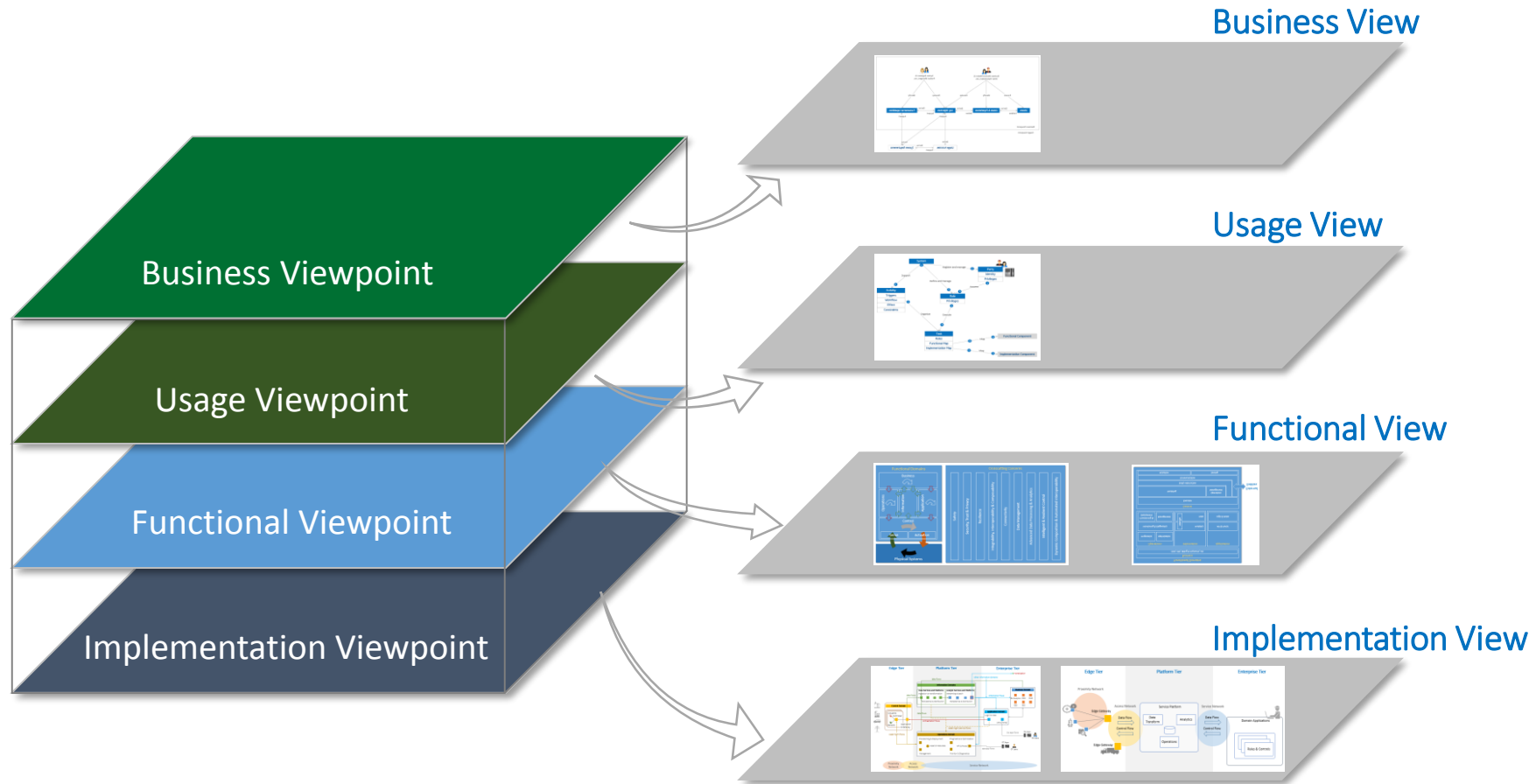
Identify & classify important system architecture concerns into related categories – viewpoints – for analysis & resolution.

Business vision & value driven, iterative design methodology





# IIRA – Concern Resolution Driven Architectural Template

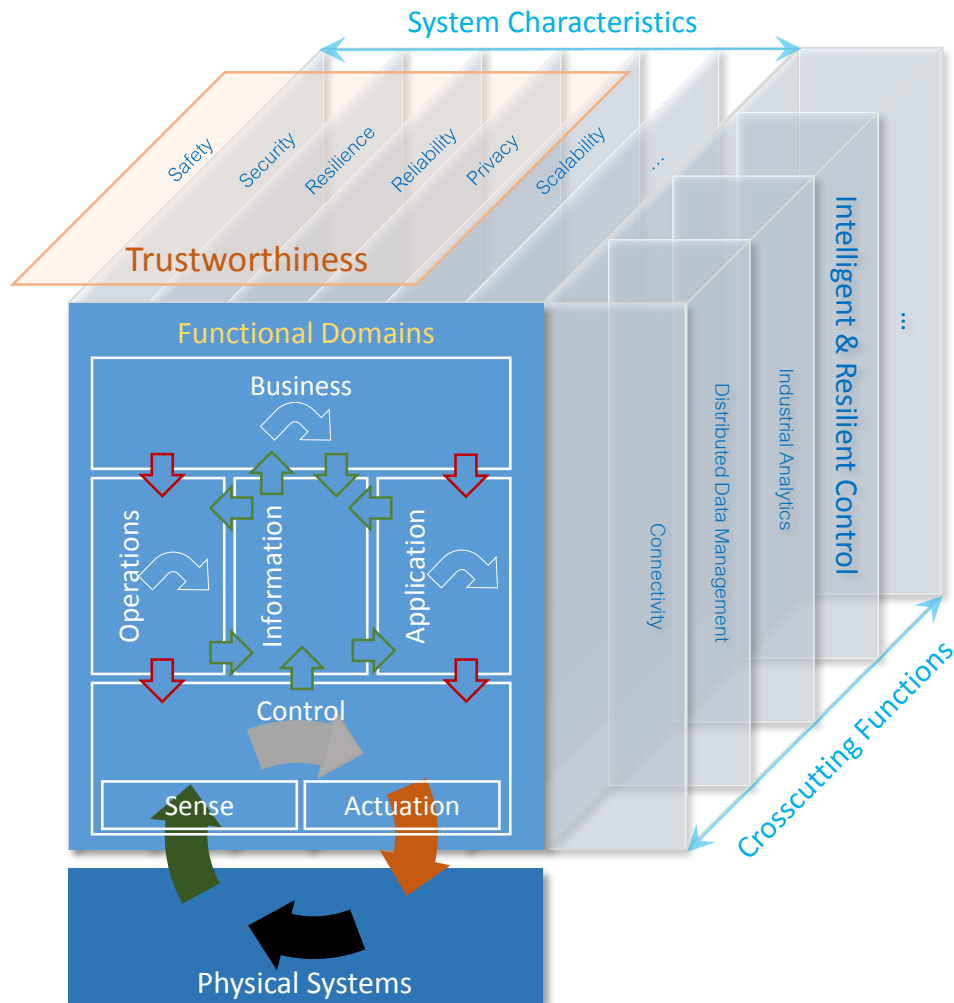


From viewpoint to view: system concern identification, analysis & resolution





# IIRA – Comprehensive System Analysis



Identify major common functional domains & their relation & interaction

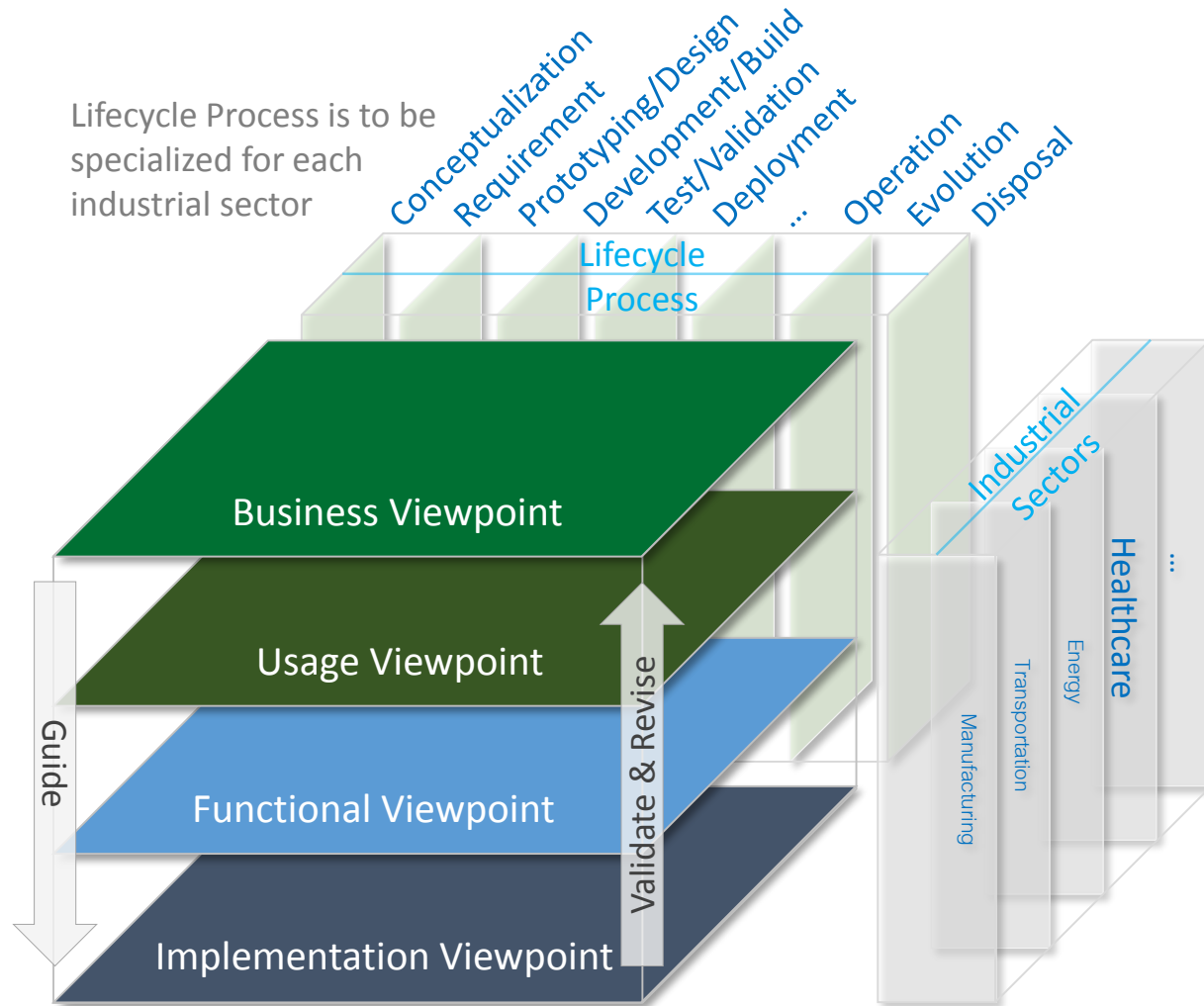
Identify major cross-cutting functions

Identify major system characteristics as emerging system properties

Introduce the concept of Trustworthiness



# IIRA – Broad Applicability



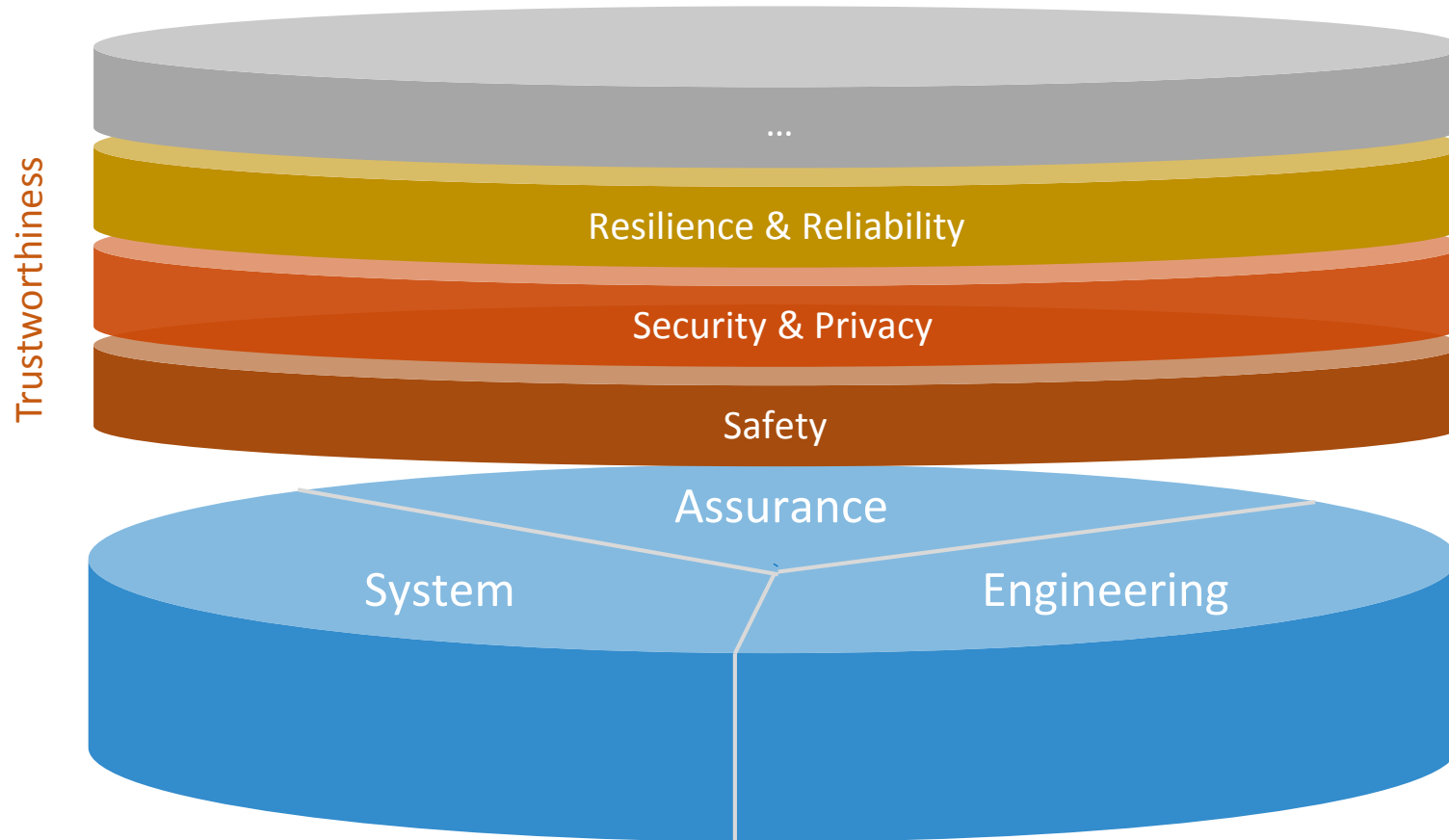
Widely applicable to virtually all industrial verticals

Provide a common & open architectural foundation for each use case & vertical to specialize & extend where it is necessary





# IIRA - Key System Characteristics & Assurance







# Looking Forward

---


Enrich architecture patterns in each of the viewpoints by providing concrete examples of the application of IIRA and a standard template for representing patterns for each of the viewpoints

Derive sector specific reference architecture based on IIRA, collect sector specific architecture patterns as feedback to IIRA

Expand architectural considerations in the Control Domain in IIRA to reflect IIoT system implementation on brownfield systems and path to future environment

Expand guidance on how to create views from each of the viewpoints with concrete examples from testbeds





# IIRA – v1.8 New Changes

---

- Improved & enhanced description of the architecture concepts & constructs with clearer alignment to ISO/IEC/IEEE 42010 Architecture Description standard & their application in the IIRA.
- A new section detailing IIRA viewpoints' scope of applicability & relationship to the system lifecycle process.
- A new section describing the relationship among functional domain, crosscutting functions & key system characteristics.
- A new section on functional domain & compute deployment.
- Clarity that the architecture patterns are representative & not all intended to be all inclusive or normative.
- A new section on Layered Databus Architecture Pattern derived from the IIC Smart Grid Testbed Program.
- A new appendix on Design Space Considerations providing a broad view of possible design parameters & their constraints in identifying, describing & resolving IIoT system concerns.
- Movement of IIRA 1.7 Part 2 to a separate volume (to be published shortly) as those sections are being replaced by the IISF, IICF, & other soon to be released stand-alone frameworks.





## IIRA - Summary

---

- A standards-based common architecture template & methodology for designing interoperable IIoT systems within & across industries
- Business value driven, comprehensive, highlighting important IIoT system characteristics – safety, security, privacy, resilience, reliability, etc.
- A foundation of identifying interoperability requirements & solutions
- A foundation for enabling & spurring innovation in an open ecosystem
- For vendors to build marketing fitting reusable products & services
- For implementers to build IIoT systems at reduced effort & costs, lower risks & shorter time-to-market

