Setting the Standard for Automation™

Introduction to ISA112 SCADA Systems Management Lifecycle

Graham Nasby, Water SCADA & Security Specialist
City of Guelph Water Services
Guelph, Ontario, Canada

Process Control & Instrumentation Webinar Series
Tuesday, July 20, 2021
Content provided as part of the Energy & Water Automation Spotlight

About the Speaker

Graham Nasby, P.Eng., PMP, CAP

Water SCADA & Security Specialist (Water Services)

City of Guelph Environmental Services

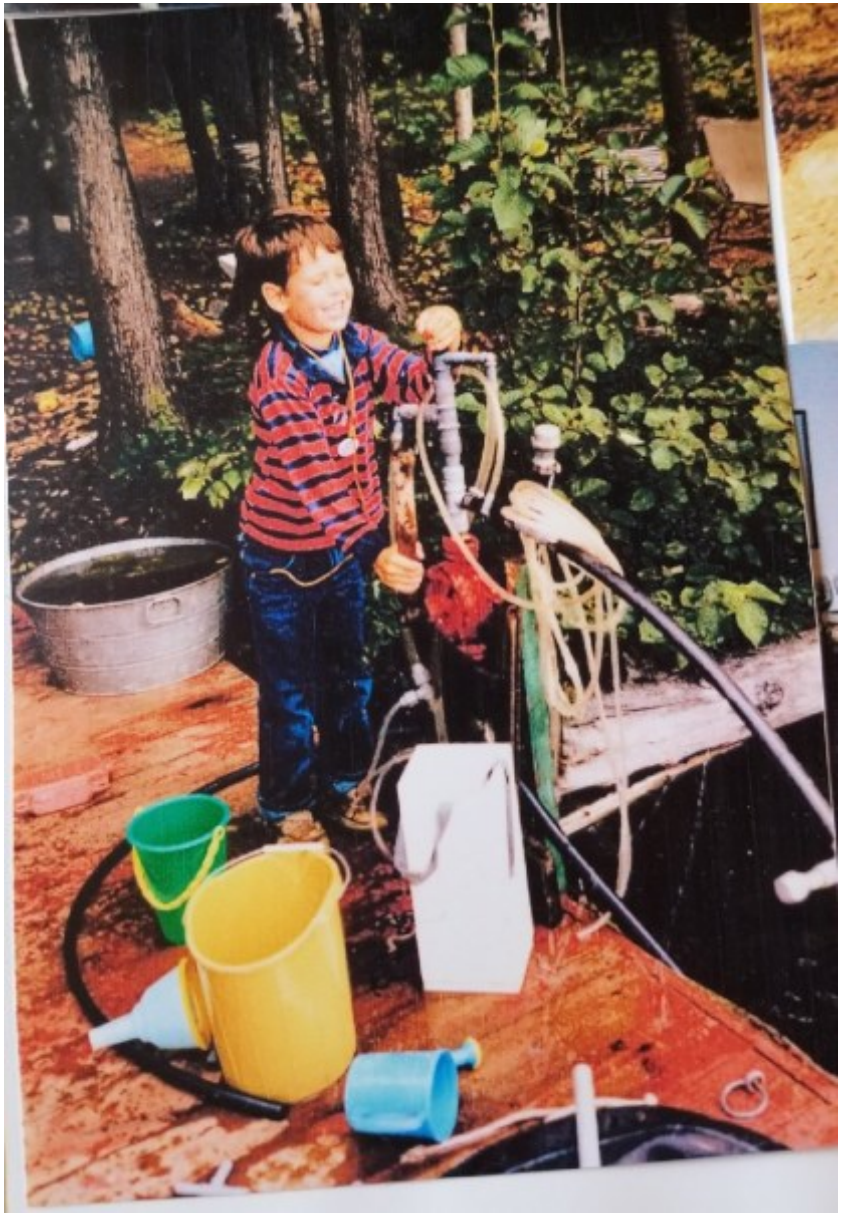
Guelph, Ontario, Canada

- 10 years in the consulting sector
- Joined City of Guelph Water Services in 2015

- Co-chair of ISA112 SCADA Systems standards committee
- Voting member of ISA101 HMI Design and ISA18 Alarm Management committees
- Past Section President, Division Director, Technical VP within ISA at the society-level
- Member of IEC/SCC TC65A “Industrial process measurement, control and automation”
- Member of CSA P125 “Operational Technology: Functional Safety and Security”
- Active volunteer with American Waterworks Association and Water Environment Federation

- Sessional instructor at McMaster University (Hamilton, ON) and Conestoga College (Cambridge, ON)
- Has published over 50 papers and articles on automation topics
- Received ISA’s technical division leader of the year award in 2013
- Received “Mid-Career Achievement Award” from his *alma mater* University of Guelph in 2014
- Recipient of the ISA’s society-level Standards Excellence award in 2021

- Contact: graham.nasby@guelph.ca



I wanna be a Water Guy when I grow up!

(SCADA systems – supervisory control and data acquisition systems – are used extensively in the municipal water sector along with many other industries.)

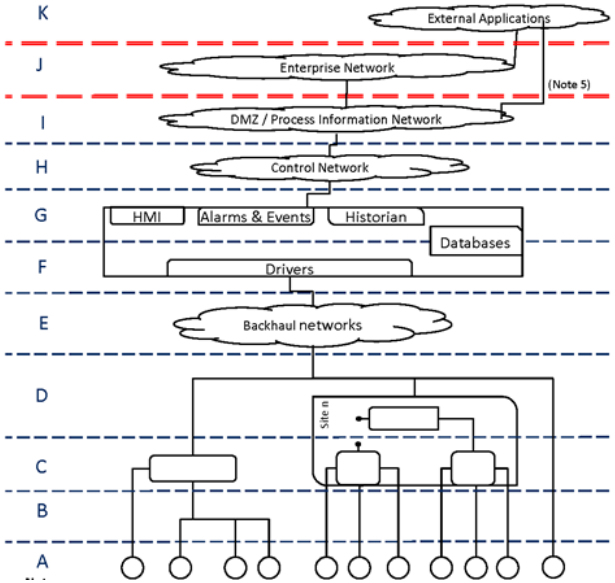
Presentation Outline

- Introduction
- SCADA Refresher
- Why develop a SCADA management standard
- Needs of SCADA stakeholders

- ISA112 SCADA Reference Architecture
- ISA112 SCADA Management Lifecycle

- Continuous Work Processes
- SCADA System Standards
- Projects – Design Work Processes
- Projects – System Development & Build Work Processes
- Projects – Installation, Commissioning Work Processes
- Operations Work Processes

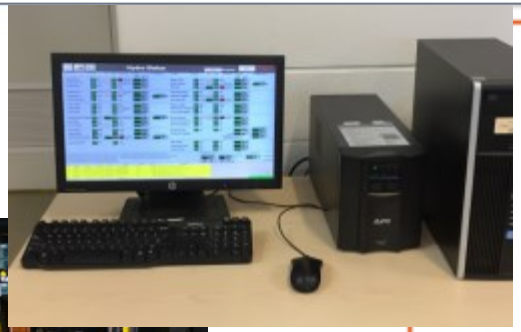
- ISA112 Lifecycle Resources and Visiting www.isa.org/isa112

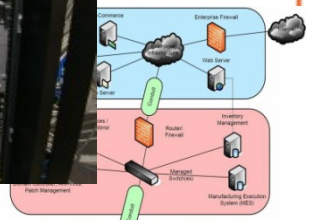


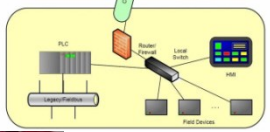
What is SCADA?

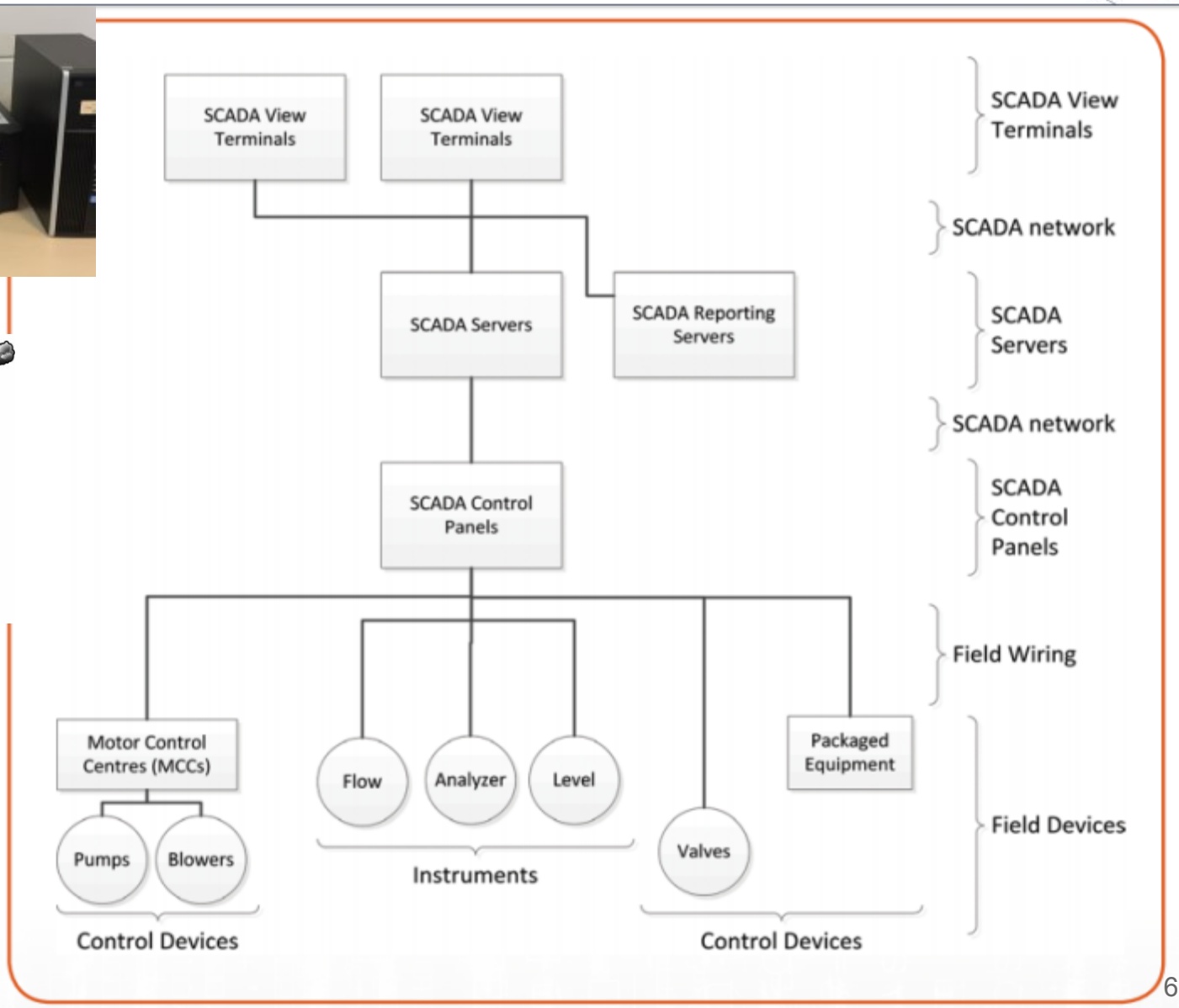
SCADA = Supervisory Control and Data Acquisition

Typical SCADA Architecture

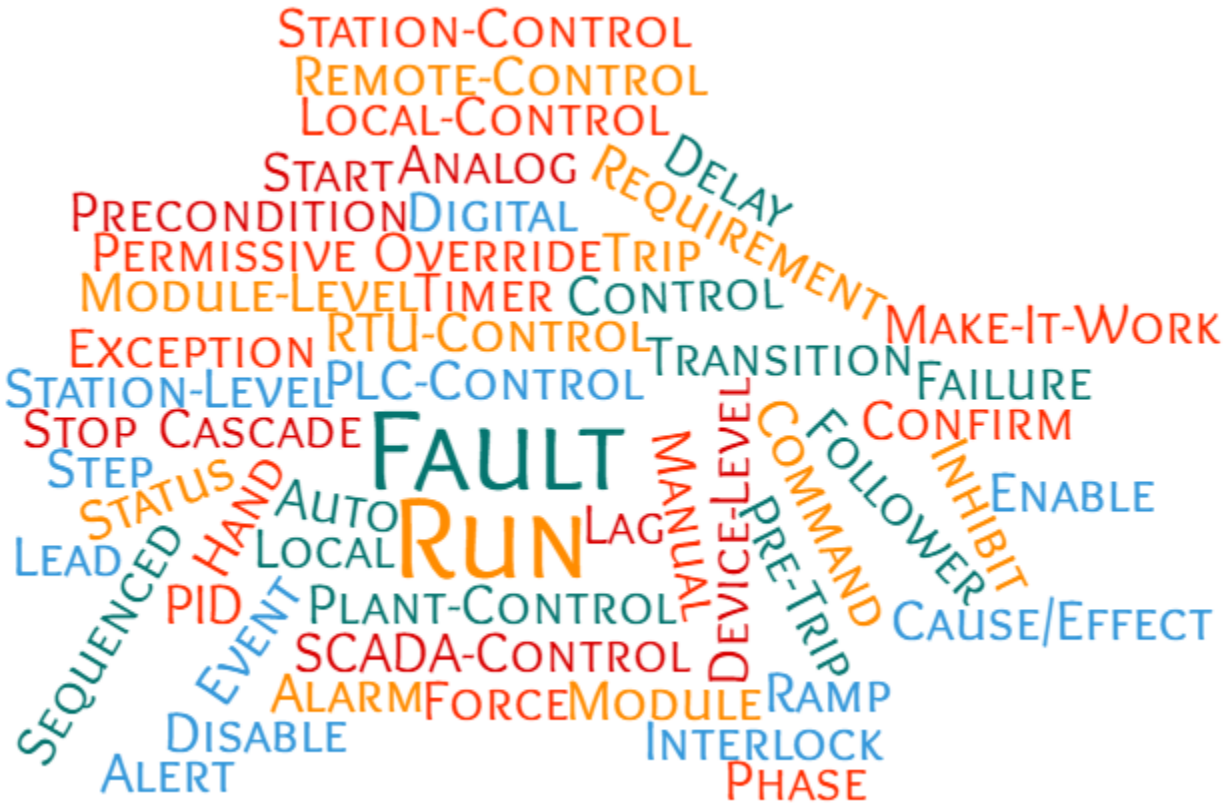








Why Designing, Building and Managing SCADA Systems is Hard



Industry/End-User Needs for ISA112

- Need for common terminology for SCADA systems
- Specification for minimum SCADA software requirements
- Suggested I/O interfaces for interfacing with equipment
- Standardized Control Modes: Remote vs. Local, Auto vs. Manual
- Reference architectures for levels of control
- Guidance for applying other ISA standards to SCADA
  - Cybersecurity
  - Alarm Management
  - HMI Design
  - Data Storage
  - Designing maintainable robust, resilient, and reliable systems

End-User SCADA Staff Needs for ISA112

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Design Consultant Needs for ISA112

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Equipment Vendor Needs for ISA112

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Contractor Needs for ISA112

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System Integrator Needs for ISA112

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What is ISA112?

- ISA112 is an open consensus-based technical Standards Committee chartered by the International Society of Automation in mid-2016

- **Committee Members:** software vendors, hardware vendors, end users, system integrators, consultants, and government from a wide variety of industries.
- Currently over 250 committee members on ISA112 from around the world.
- ISA112 is open any interested individual from any industry (both ISA members & non-members)
- The ISA-member members of ISA112 belong to a wide-variety of ISA sections & divisions

- **Goal:** Develop a series of ISA standards and technical reports that provide guidance for system design, implementation, operation, and maintenance of SCADA systems for pipelines, water and wastewater, power, oil and gas, and other industries to support the overall integrity and reliability of these systems.

Developing the ISA112 SCADA Standard

- Defining an inclusive definition of a “SCADA System”
- ISA112 SCADA System Reference Architecture Drawing
- ISA112 SCADA System Lifecycle Diagram
- Working Table of Contents
- Key SCADA Definitions
- In progress text for ISA112 standard and technical reports

Current Status of ISA112

Jun 2016	Committee approved by ISA
Aug 2016	Initial call for volunteers (40 members)
Sept 2016	First meeting held in Newport Beach, California, USA
Jan 2017	Committee co-chairs named -Graham Nasby, City of Guelph Water Services (Guelph, Ontario, Canada) -Ian Verhappen, Willowglen Systems Inc. (Calgary, Alberta, Canada)
Apr 2017	Monthly conference calls start
May 2017	Second meeting in Raleigh, North Carolina, USA Semi-annual face-to-face meetings start
May 2018	ISA112 Lifecycle & Architecture Diagram Developed
Nov 2018	Table of Contents Developed
2019-2020	Writing Phase begins, as of June 2021 we have 500 pages of rough draft content, which will be to be split between standard and technical reports. 75 active authors
July 2020	**Release of ISA112 lifecycle and architecture diagrams at http://www.isa.org/isa112**

- 2021-2022 – Document Development / Section Working Groups
- 2022-2023 – Commenting/Editing rounds
- **2023-2024 – Expected Publication of official ISA112 standards documents**

What is a SCADA System?

ISA112 Definition - Supervisory Control and Data Acquisition

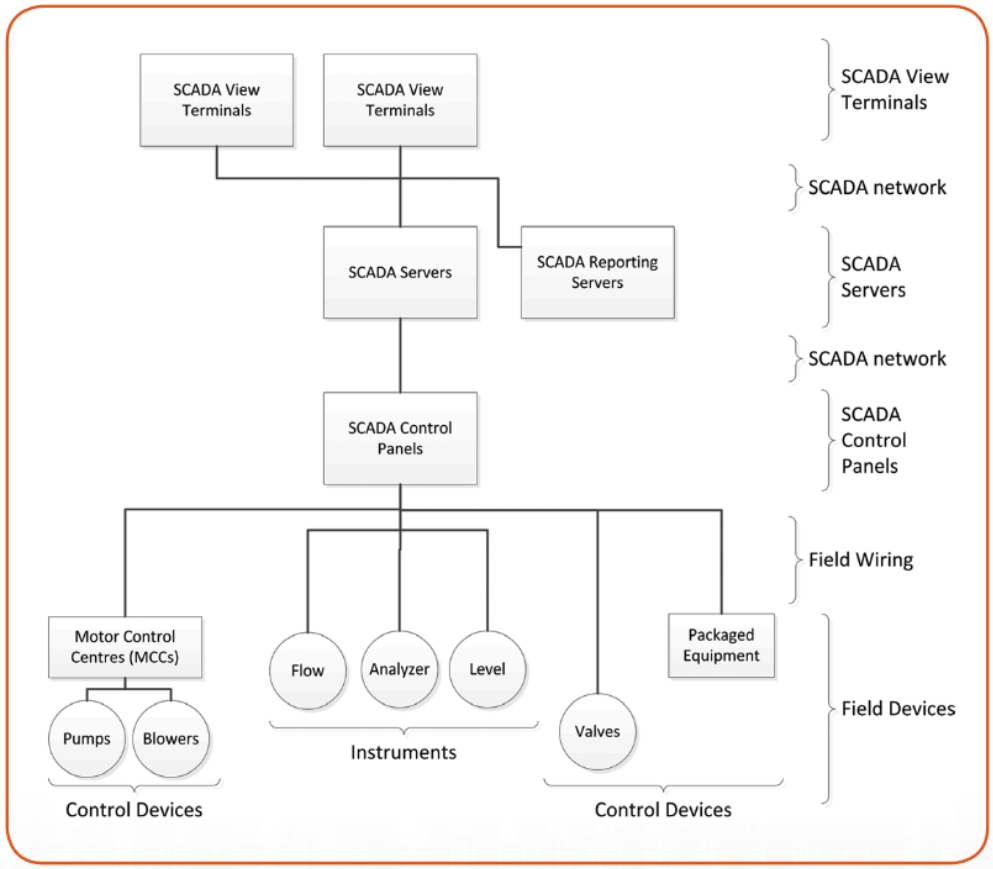
"SCADA = a system which is a combination of hardware and software used to send commands and acquire data for the purpose of monitoring and controlling."

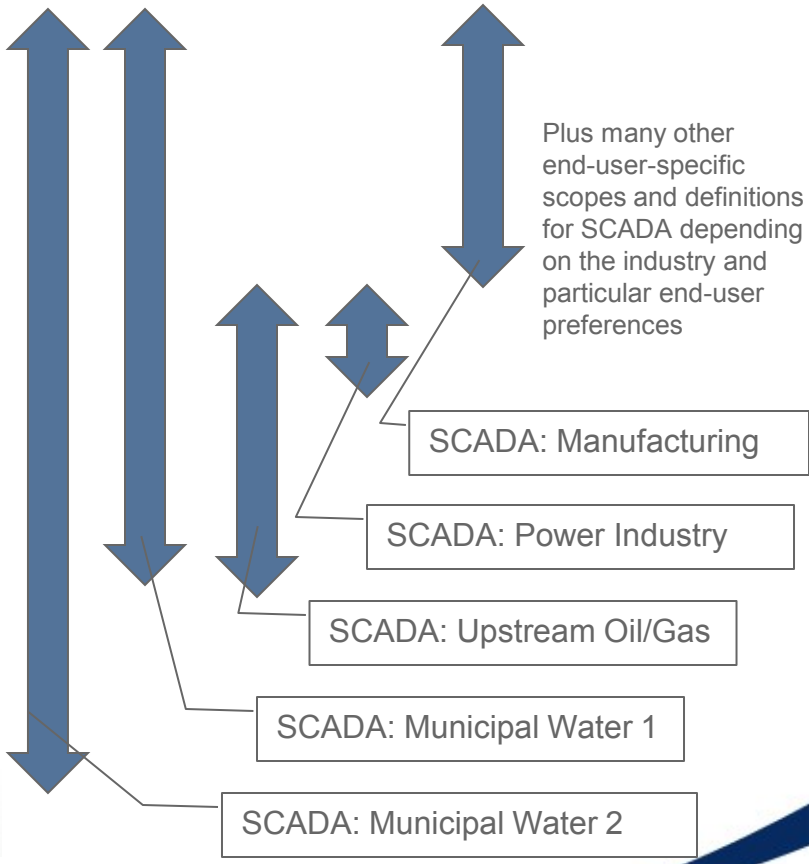
(DEFINITION AS ADOPTED AT THE MAY 5, 2017 MEETING OF ISA112 IN RALEIGH, NORTH CAROLINA, USA)

Different Industries use the term "SCADA" to mean many different things that are specific to that individual industry. Each of these industries is correct in how it uses the term SCADA within its own context. We must be aware of this, and our definition and standard must be written so that it can be used by all industries.

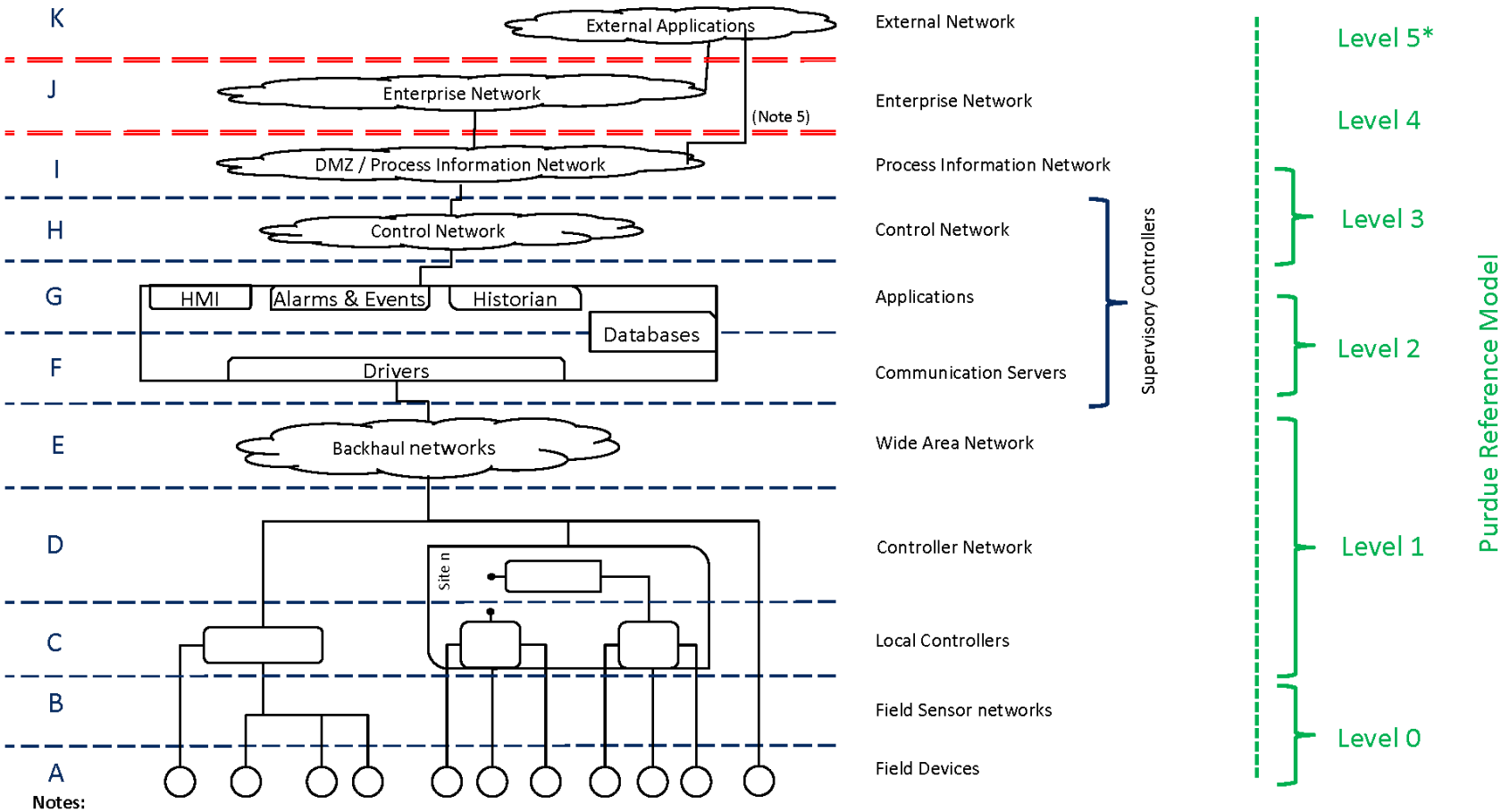
Term "SCADA vs. Various Industries & Areas

- Examples of differing definitions of SCADA by industry
- Definitions can also vary by geographic area/country





ISA112 SCADA System Architecture

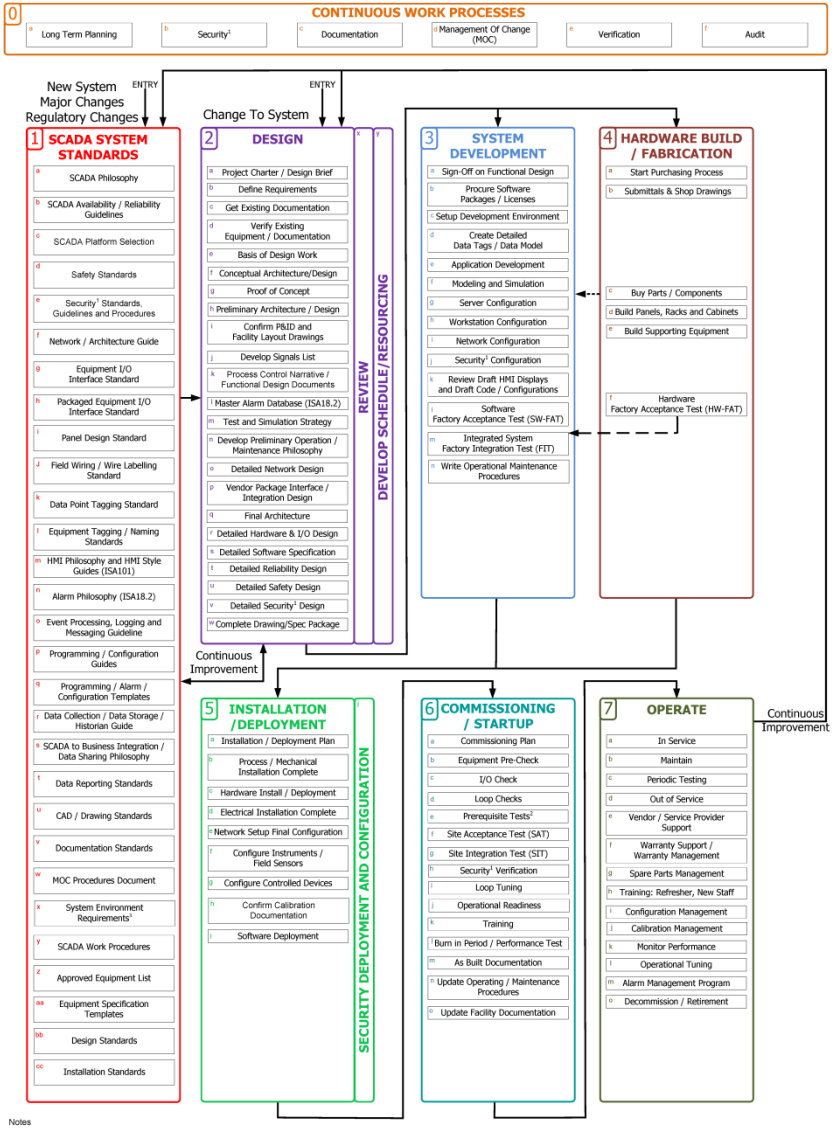


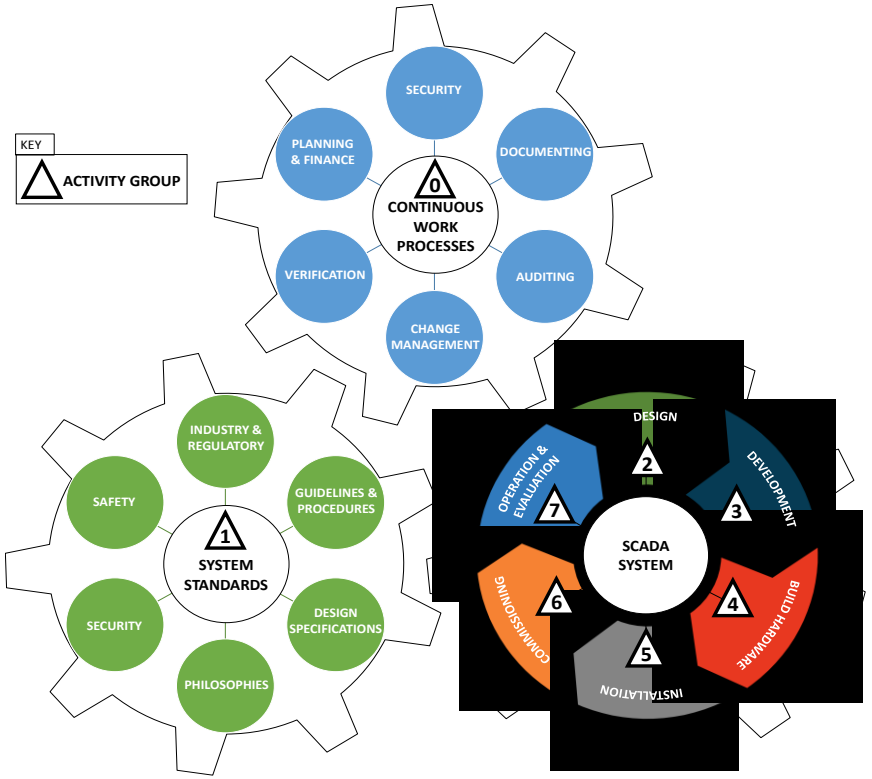
Notes:

1 Letters are used to avoid potential conflict with ISA-95 and other "Layer" models.
2 Routers and Firewalls between layers are not shown.
3 Other system-specific servers, applications ,and workstations are not shown.
4 Communications for any remote-hosted external applications (Cloud) with lower levels must be done using extreme care.
5 The use of direct-connections for remote applications is strongly discouraged. Refer to ISA/IEC-62443 for guidance on an appropriate zone/conduit implementation.
* We show a Purdue Level 5. The true Purdue Model only has levels 0-4 because it did not anticipate external applications.

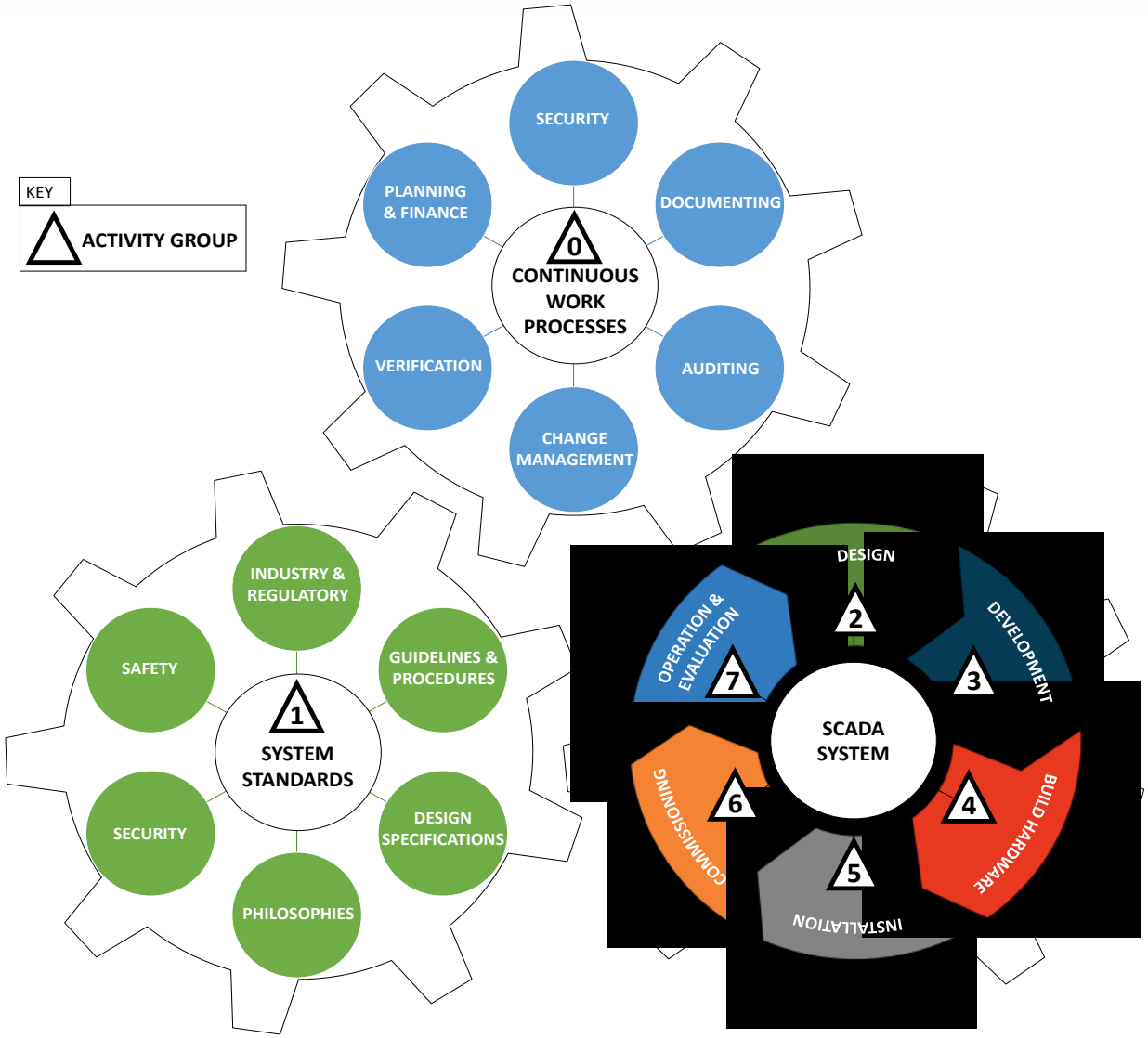
Revision May 28, 2020

SCADA Systems Lifecycle Diagram

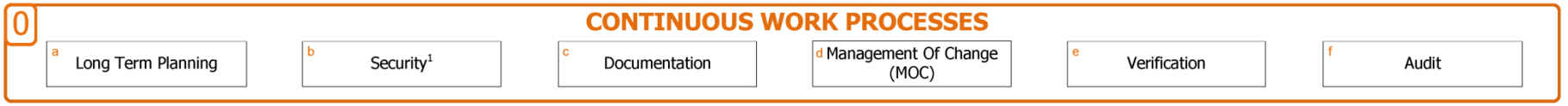




ISA112 SCADA Systems Lifecycle Diagram



ISA112 SCADA Continuous Processes



Long Term Planning – Planning for 5, 10, 15, 20, 25+ year outlook

Security – Physical Security, Operational Security and Cybersecurity

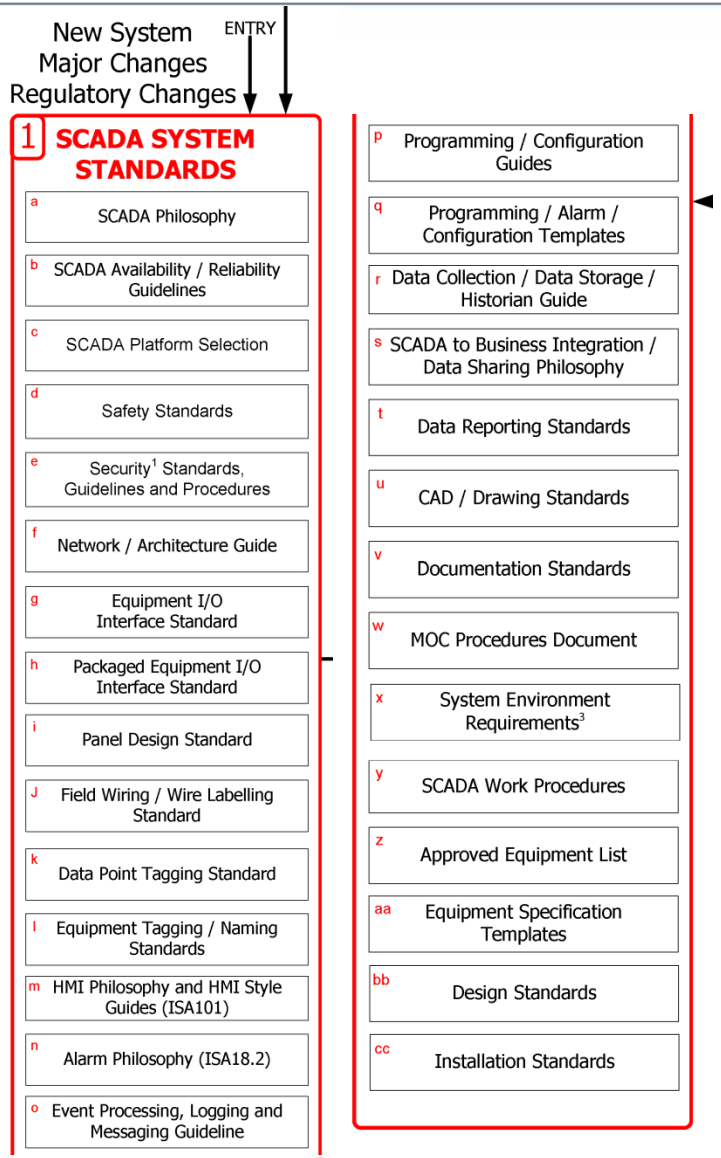
Documentation – Ongoing documentation of the system for operations

Management of Change (MOC) – Managing/controlling system changes

Verification – SCADA system is working the way it is documented

Audit – Ensuring work processes are being followed and documented

SCADA Facility System Standards

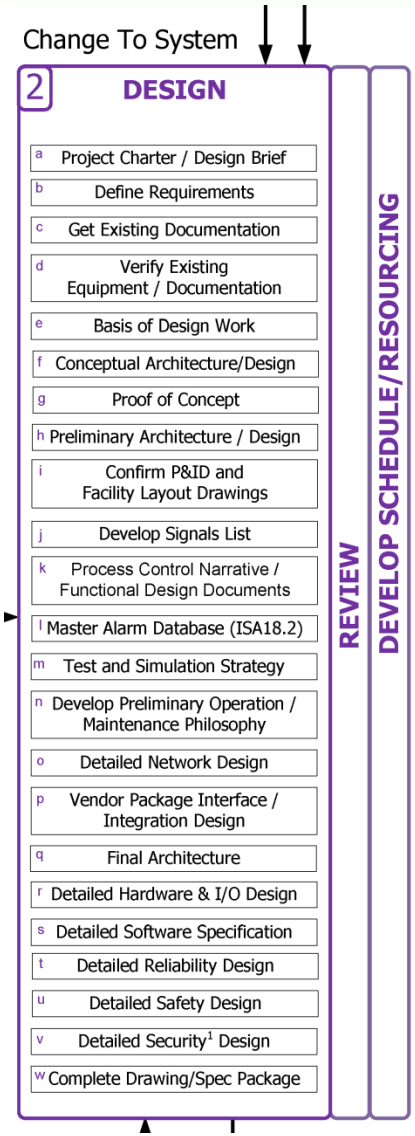


SCADA Philosophy Document
SCADA Availability/Reliability Guideline
SCADA Platform Selection
Safety Standards (for automatic shutdown systems)
Security Standards, Guidelines and Procedures
Network / Architecture Guide

Equipment I/O Interface Standard
Packaged Equipment I/O Interface Standard
Panel Design Standard
Field Wiring / Wire Labelling Standard
Data Point Tagging Standard
Equipment Tagging / Naming Standards

HMI Philosophy and HMI Style Guides (ISA1010)
Alarm Philosophy (ISA18.2)
Event Processing, Logging and Messaging Guideline
Programming / Configuration Guides
Programming / Alarm / Configuration Templates
SCADA to Business Integration / Data Sharing Philosophy
Data Reporting Standards
CAD / Drawing Standards
Documentation Standards
MOC Procedures Document (Change Management)
System Environment Requirements
SCADA Work Procedures
Approved Equipment List
Equipment Specification Templates
Installation Standards

SCADA Design Work Process



Project Charter / Design Brief
Define Requirements

Get Existing Documentation
Verify Existing Equipment/Documentation
Basis of Design work
Conceptual Architecture/Design

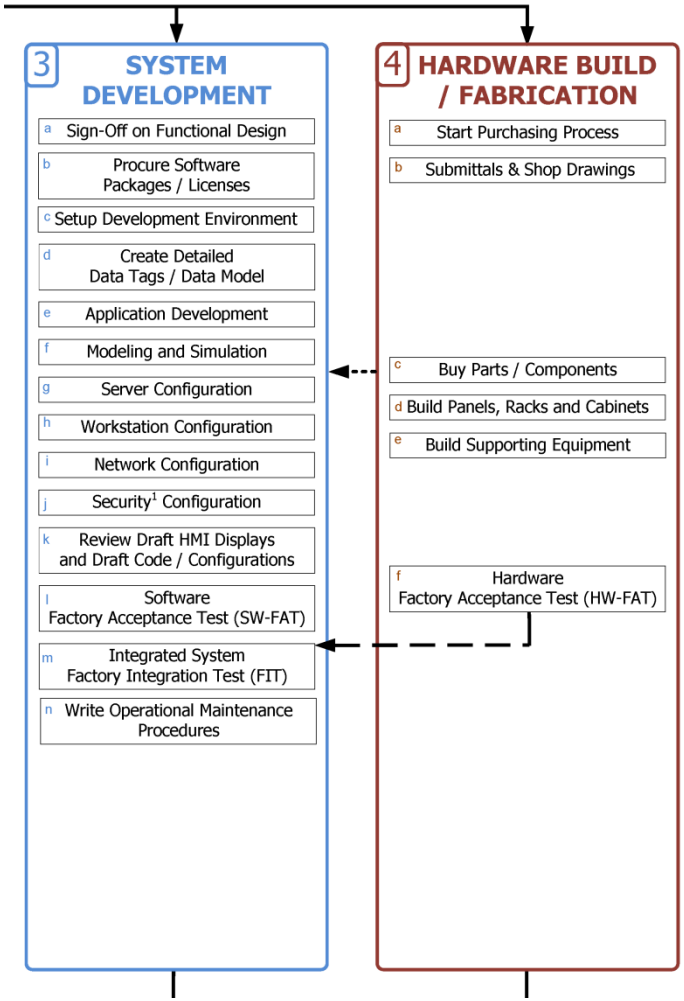
Proof of Concept
Preliminary Architecture/Design

Confirm P&ID's and Facility Layout Drawings
Develop Signals List
Process Control Narrative / Functional Design Documents
Master Alarm Database (ISA18.2)
Test and Simulation Strategy
Develop Preliminary Operation / Maintenance Philosophy
Detailed Network Design
Vendor Package Interface/Integration Design
Final Architecture

Detailed Hardware & I/O Design
Detailed Software Specification
Detailed Reliability Design (UPS's, redundant equipment)
Detailed Safety Design (automatic shutdown systems)
Detailed Security Design (check of security & cybersercurity details)

Complete Drawing/Spec Package (for group that will do building/programming)

ISA112 SCADA Development & Hardware



System Development

- Sign-Off Functional Design Doc (Process Control Narrative)

- Procure Software Packages / Licences
- Train Software Development Team
- Setup Development Environment
- Create Detailed Data Tags / Data Model
- Application Development (PLC & HMI Programming)
- Modelling and Simulation (so one can test as they program)

- Server Configuration
- Workstation Configuration
- Network Configuration
- Security Configuration (check all security settings are right)

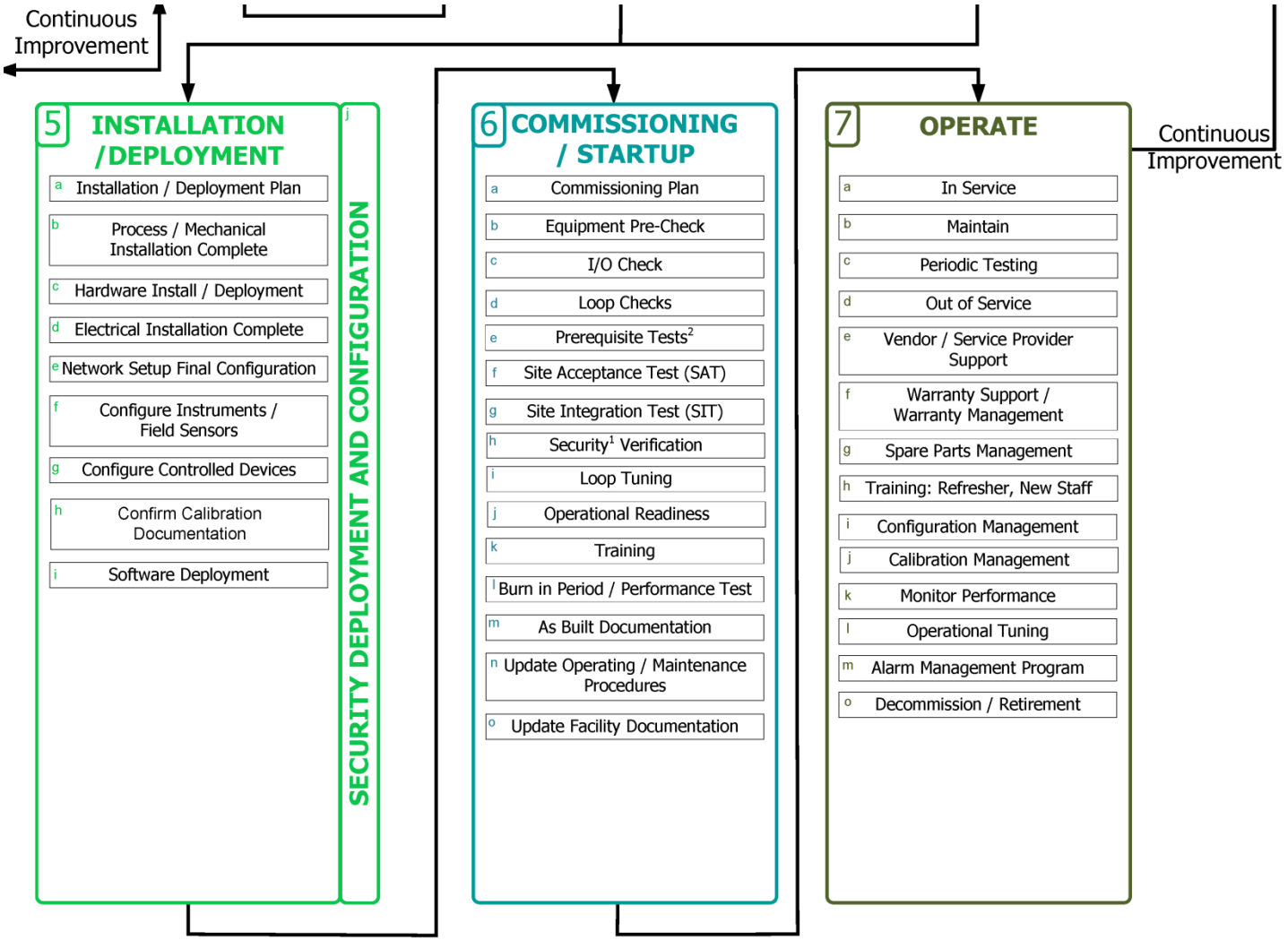
- Review Draft HMI Screens and Draft Code / Configurations
- Software Factory Acceptance Test (SW-FAT)
- Integrated System Factory Integration Test (FIT)
- Write Operational Procedures (how to use the control system)
- Develop Software Training Materials

Hardware Building / Fabrication

- Start Purchasing Process
- Shop Drawings / Submittals
- Buy Parts / Components
- Build Panels, Racks and Cabinets
- Build Supporting Equipment

- Hardware Factory Acceptance Test (HW-FAT)

ISA112 SCADA Install, Commission, Operate



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ISA112 SCADA Resources & Tools

- www.isa.org/isa112
  - Freely available pdf copy of ISA112 SCADA management lifecycle
  - Freely available pdf copy of ISA112 SCADA model architecture
  - List of committee members, copies of presentations/articles, and other materials

- ISA112 upcoming publications
  - ISA112 Part 1 – Terminology, Diagrams and Definitions
  - ISA112 Part 2 – SCADA Systems Management Lifecycle
  - ISA112 Part 3 – SCADA Systems Model Architecture

- ISA112 Technical Reports
  - Titles and Topics TBD
  - To be focused on examples and best practices for “how” to implement SCADA systems
  - Will likely also include industry-specific and application-specific best practices guides

More Information on ISA112

- www.isa.org/isa112/
- Download the current ISA112 lifecycle & diagrams
- Contact the ISA112 committee co-chairs
  - Graham Nasby
    graham.nasby@guelph.ca
  - Ian Verhappen
    ian.verhappen@willowglensystems.com

The ISA112 committee is still looking for volunteers from end-users, vendors, system integrators, consultants, utilities, and government to help with writing, editing and reviewing content. Contact the committee co-chairs for more information or visit www.isa.org/isa112/

Upcoming Related Events

- For more information on upcoming webinars, virtual conference events and resources, visit: www.isa.org/virtualevents.

- Continue the conversation on this topic in the Technical Discussion Forum at: https://connect.isa.org.

Not an ISA member?

- Visit: www.isa.org/membership for more information on how to join and get involved.