Setting the Standard for Automation™

Automation Master Planning & Developing Effective Automation Standards for your Facilities

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About Your Speaker

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- System Integrator with Eramosa Engineering
- Director-elect of the ISA Water/Wastewater Industries Division
- General Chair for the 2012 & 2013 ISA Waster/Wastewater Symposiums
- Member of the ISA18, ISA101 and CSC/IEC/TC 65 standards committees

- In 2011 received Control Engineering magazine's "Leaders Under 40" award
- Recipient of ISA Keith Otto Award for best *InTech* magazine article of the year for his "SCADA Standardization" article in the May/June 2011 issue.
- Nominated for the national-level 2012 Allen D. Williams Young Professional Award from the Association of Consulting Engineering Companies of Canada (ACEC)
- Background in various industry sectors including municipal water/wastewater

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Presentation Outline

- Need for Automation Master Planning & Facility Standards

- SCADA Master Planning Process
- Discovery & Identifying Stakeholder Needs
- Technology Assessment Process
- Developing a Plan, Writing it down, and Keeping it Current

- Facility Automation Standards
- What they are and What they are not
- Developing and Maintaining Facility Standards
- How to Use Effectively

- Case Studies
- Summary

The Need for Master Planning & Standardization

- Automation continues to be a rapidly evolving field
- Cost vs. Functionality ratio continues to improve
- We can now do things that were cost prohibitive before

- Large projects are often tendered, so it can be a different integrator each time

- There is a tendency to install the “latest and greatest” on projects
- When done over 10-20 years, the resulting systems can be very complex
- Complexity in automation systems is magnified because everything has to communicate

- Non-standardized & complex systems can have very high operating and maintenance costs

Motivators: Reducing Automation Complexity

- Automation Systems built over time can become very complex due to components having varying feature sets, connectivity, programming and vendor support

- Some of the many hidden costs of complexity
  - Harder to maintain & troubleshoot
  - Broader skill sets needed for operators, maintenance, engineers, programmers, etc.
  - More training to keep your staff up to date
  - More use of external consultants to cover skills not available in-house

  - Additional site visits by staff needed since equipment status reporting to HMI varies
  - More possibility for mistakes since not all systems have same status detail on HMI
  - Multiple vendor support contracts (one for each type of equipment/network)

  - Additional costs from extra time/effort needed to add new equipment to system
  - Ongoing difficulties trying to get incompatible equipment/networks to talk to each other
  - Signal converters, bridges, and protocol converters are often not as robust as native communications

Motivators: Training & Ease of Operation

- Complex systems are harder to operate and require more training

- Organizations that have multiple sites can have significant variation between sites due “organic” development over time
  - Even if two plants start off as being identical, they will diverge from each other over time if no facility standards or master plan is in place

- The result is staff from one site often cannot operate other sites effectively
- If staff are expected to operate multiple sites, the additional ongoing training costs can be extensive

- Automation Standards reduce complexity and variation between sites
  - Lower training costs
  - Better utilization of operations, maintenance and engineering staff

Motivators: Capturing Institutional Knowledge

- When a new plant is designed or an existing plant is upgraded, where does the direction of “how to do it” for Automation come from?

- Automation details are often one of the last things a plant designer thinks about
- Control system design often gets rushed with “just get it done mentality”
- When older workers retire, we need an easy way to capture their knowledge

- Automation Master Plan & Automation Standards help by:
  - An easy place to record institutional knowledge
  - A resource to use when doing the control system design
  - Repository of “how we do things” that guides operations/maintenance
  - A great resource when training new staff

- Invaluable when external contractors or consultants are used
  - Without facility standards, how else do they know how you want things done?

Motivators: Capturing Lessons Learned

- Construction projects always have lessons learned associated with them
- However, at the end of construction projects
  - Focus is usually on getting project wrapped up
  - Construction specs and drawings are typically not updated to “as built”, and are often not reused on new projects – so lessons learned are lost
  - Few people have the motivation to write down lessons learned at end of project
- Capture Lessons Learned in your Facility Automation Standards
- Easily done as part of a “living document” standards program

Motivators: Overall Cost Savings

- Automation Master Plan & Facility Automation Standards **save money!**
- In the long run
  - Less time spent on “custom design”
  - Less “design-risk” as automation approaches/designs are standardized
  - Easier construction
  - Easier to administer construction contracts
  - Easier for contractors and consultants to build plants the way you want them to
  - Easier programming and more robust code
  - Easier to train staff on standardized systems that are consistent plant-to-plant
  - Get to re-use knowledge, ideas and templates that have been previously developed; helps drive contiguous improvement methodologies
  - Savings on maintenance, troubleshooting and spare parts costs
  - Standardized automation systems mean less chance for mistakes

Embarking on Master Planning & Standardization

- When to Develop a Master Plan
  - You, and your organization, have enough experience with automation systems to understand what it can and cannot do
  - Know what you want
  - Know what you don't want
  - Understand the technical requirements of your region/facilities
  - Understand the needs of your user groups (operators, maintenance, engineering, etc.)
  - Understand the capabilities of vendors, integrators and in-house staff

- Resources Required
  - Must have the support of your management and procurement dept.
  - Need users who want to participate (operators, maintenance, engineering, etc.)
  - Need to have an overall long term Master Plan for your waterworks already
  - Be prepared to do some work before you see it pay off
  - Be patient as developing standards takes time and is an iterative process
  - Have a vision

Automation Master Planning Process

- Discovery
- Stakeholder Identification & Needs Analysis

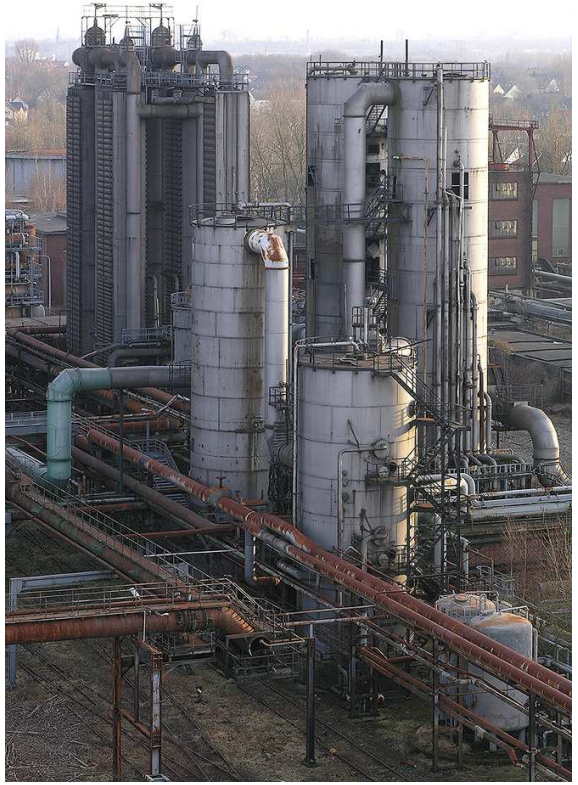
- Current Technology Assessment
- Assessing Trends & Opportunities
- Creating Goals & Long Term Vision

- Developing the Plan
- Strategic Decisions
- Transition Planning

- Writing it Down
- Review Regularly

Master Planning - Discovery

- Figure out what you currently have
- Taken an inventory of what automation technology is in use
  - Instrumentation
  - Valves, Drives, and Controllers
  - PLC
  - HMI
  - SCADA
  - DCS
  - Control Panels & Field Panels
  - HMI Design & Programming
  - Alarm Management Systems
  - Data Logging & Storage
  - Reporting Systems



- Who is using the Automation System?
- Is it doing what they need it to?

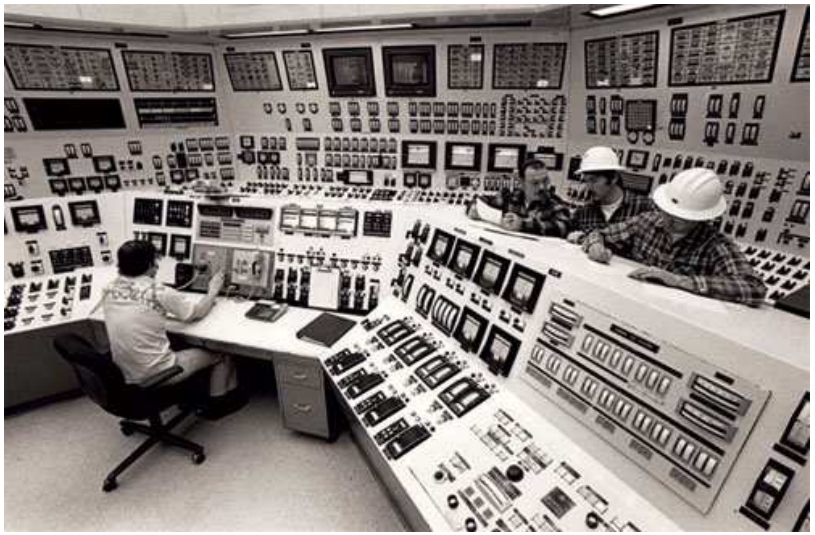
Master Planning – Stakeholder Identification

- Identify who uses the Automation System
- Obvious stakeholders
  - Operators
  - Engineers
  - Maintenance
  - Plant Manager

- Less obvious stakeholders – these user groups use data and reporting from the automation system
  - Executive / Business Office
  - Sales & Customer Service
  - Purchasing & Accounting
  - Long Term Planning
  - Health and Safety Department
  - Regulatory Affairs Department

Master Planning – Stakeholder Needs Analysis

- Methods
  - Subject Matter Experts
  - Questionnaires
  - Job and Task Descriptions
  - Interviewing Stakeholders
  - Written Work Descriptions
  - Facilitated Workshops
  - Observing Operators at Work
  - What If Analysis
  - Use Case Analysis



- Look Carefully at Needs vs. Wants

- Also want to keep Cost vs. Benefit of providing features in mind

Master Planning – Assessing Trends & Opportunities

- What are the current trends in your industry?
  - Market Trends
  - Regulatory Trends
  - Environmental Trends
  - Technology Trends
  - Changing Social Norms

- Corporate Strategy
  - Is your automation system helping or hindering?
- Enterprise Integration Plans
  - Can the automation system bring data off the plant floor?
- Operational Efficiency
  - Can small changes in the automation system offer competitive gains?

Master Planning – Current Technology Assessment

- Look at what equipment is installed (from Discovery)
- Compare to the Needs/Wants of the User Groups (from Stakeholder Analysis)
- How does it fit in with current trends (Trends & Opportunities Analysis)

- What gaps are there?
- What is the current system good at?
- What is it bad at?

- Is current technology directional or is it nearing end-of-life?
- What is the vendor's current plan for future products and support?
- Can your staff operate and maintain it effectively/efficiently?
- How complex is the system?
- Is it doing what you need now? What about in 5, 10, 15 years?

- Will any of the "wants" become "needs" in the near future?

Master Planning – Looking at Alternatives

- Look at other Automation Technology Options
- Are there other systems out there than can fill your needs/wants
- Is there vendor support? Is the product directional?
- Upfront capital cost vs. ongoing operating/licensing costs

- What staff resources and training would be required?
- Are there local integrators and specialists available to help with large projects?

- Look at what would be involved to change: cost, risk, and time
- Would there be any benefit to switching?
  - Operations
  - Maintenance
  - Productivity
  - Overall costs

Master Planning – Form a Vision

- Where do you want to be in 5, 10, 15, 20 years?
- Develop a vision and write it down
- This forms the starting point for your Automation Master Plan

- Next make strategic decisions on major items
- What “big pieces” of technology do you want to use
  - PLC, RTU, SCADA, DCS or packaged systems
  - Central Control System or Distributed Control Systems
  - Maybe a combination of the above
  - Type of automation network and how to secure it
  - Key pieces of equipment
  - Other major technology decisions

- Transition Planning
  - How you plan on getting from present situation to your vision

Master Planning – Write it Down & Keep it Updated

- To be useful a Master Plan **has to be written down & distributed**
- Can be anything from a 6 page document to multiple-volumes depending on needs

- Things to include:
  - Statement of Vision
  - List of Stakeholders and their identified needs/wants
  - Description of the current automation system
  - Identified strengths and weaknesses of current system
  - Results of analysis of alternatives
  - Description of the end-goal automation system
  - Descriptions of staged improvements of automation systems over time
  - Concrete plan of how to upgrade/develop systems towards this goal

- Plan to keep it updated
  - Commitment to frequently review/update the master plan (at least annually)

Implementing Your Plan

Automation Master Plans

are implemented using

Facility Automation Standards

Developing Facility Automation Standards

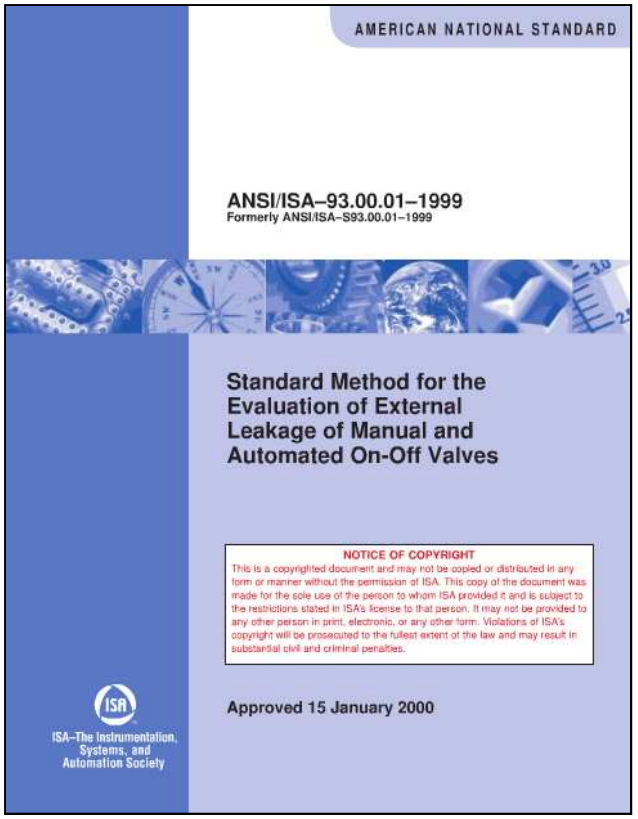
- What is a Standard?
- Industry Standards vs. Vendor-provided Standards vs. Facility Standards

- What goes in Facility Automation standards
- Characteristics of effective Facility standards
- List of typical facility standards
- Guidance on some specific facility standards

- Developing Facility Standards
- How to use Facility Standards Effectively
- How to using Facility Standards with Construction Projects
- How to keep them relevant and updated

What is a Standard?

- A set of characteristics, quantities, or procedures that describes features of a product, process, service, interface, or material
- Standards provide numerous benefits in automation and production
- A “standards series” can often include Standards, Recommended Practices, and/or Technical Reports
- Format can be printed documents, PDFs, downloadable files, or templates



Published vs. Vendor vs. Facility Standards

- When an ISA member thinks “Standards” they usually mean a published “standards document” produced by a standards organization
  - e.g. ANSI/ISA-5.1-2009, Instrumentation Symbols and Identification

- However from a facility owner’s perspective, a “standard” is usually means any document/template that is used for more than one project.

- Thus we have:

Published Standards	Published by a standards organization, typically written using a open, consensus-based, balanced approach for broad industry applicability
Vendor Standards	Supplied by a vendor to give “best practices” for implementing their product well (in their opinion)
Facility Standards	Developed by the facility owner, for use with their specific facilities only. Can cover any aspect.

About Facility Automation Standards

- Automation Standards are the tool used to implement Automation Master Planning
- Facility Standards “enforce” the Automation Master Plan
- Developed in-house by the facility owner
- Only cover what the owner feels is important
- Can be broad performance-based standards

  OR
- They can be very software, hardware or vendor specific

Characteristics of Effective Facility Standards

- Must have support from management and purchasing to use on every project, no exceptions
- Cover tools, techniques and decisions that regularly come up on automation project
- Only write down what you need, and no more
- It is important to write down the “how” as well as the “why”
- If an approach, design, technique has been used in 3 or more projects, it should be added to the facility standards so it can be used elsewhere
- Maintain some flexibility – think “recommended practices” to allow for variations in site conditions

How to use Facility Automation Standards (FAS)

- For in-house projects,
  - Need a mandate from management to use FAS
  - Have copies readily accessible in both print & soft copies
  - Allow staff to participate in the regular reviews/updates
  - Encourage suggestions for updates

- For tendered projects
  - FAS must be made part of the original contract documents, otherwise contractors will ignore them
  - Same goes for A/E firms under contract
  - Attaching FAS as an “Appendix” to engineering specs is very effective

  - Include “Contractor is responsible for obtaining most recent copy of FAS from owner and following said document” in the tender documents. Avoids sites being designed to old FAS versions. Contractors will bid accordingly.

Facility Standards – Commonly Used Standards

- Standards are how you communicate and implement your Automation Master Plan
- Documents to consider:
  1. Tagging Standard (Sites, Equipment, Electrical, I/O points)
  2. Control System Network Equipment and Addressing Standard
  3. Control Panel Specification (equipment, layout, wiring methods, etc.)
  4. Field wiring specifications / loop drawing standards
  5. Instrumentation, Valves, Motor Starters/Drives, Special Equipment
  6. List of Approved PLC/RTU/DCS/Controller Hardware
  7. Controller Logic Programming Standard
  8. Standardized Visualization software platform specification (DCS, SCADA, HMI)
  9. HMI Screen Design & Programming Standard
  10. Alarm Management Strategy/Standard (bonus points for using ISA-18.2)
  11. Data-Logging, Historian, Data Redundancy and Reporting Implementation Guide
  12. Other aspects of your workflow

CASE STUDIES

Case Study #1 – City of Guelph Waterworks

Municipal water utility for a city of 125,000

- 2002 Discussions begin about developing a SCADA Master Plan
- **2003 Draft Standard Released**
  - Tagging, Control Panel Design, PLC Hardware, PLC Code Structure, Process Control Narrative Template
- **2003-2005 Draft Standard tested on pilot sites** → successful experience
- **2005 First Standard Released**
  - SCADA Master Plan, Tagging, Control Panel Design, PLC Hardware, PLC Code Structure, HMI Software Suite, HMI Screen Layouts, HMI colors and icons, HMI pop-up windows, HMI Scripting, Alarming Guidelines, Alarm Paging, Historian Specs, Redundant Data Logging Guidelines, Process Control Narrative Template
- **2005 Core network/server upgrades (Woods Pumping Station) to support standard**
  - Fiber optic networking infrastructure, new redundant SCADA servers
  - Upgrade program for SCADA network started
- **2005 Started using the SCADA standards as part of contract documents for all capital projects**
- 2005 Capital upgrades program for all SCADA equipment across city begins
- 2005-2009 Incremental updates to SCADA standard as needed
- **2009 Updated Standard released for PLC Programming (existing PLC platform)**
- **2009 Updated Standard released for PLC Programming (new PLC platform)**
- 2010 SCADA network upgrade complete, all sites now using fibre optic Ethernet network
- **2011-2012 Updated HMI Standard planned (once a major HMI server upgrade is completed)**
  - Standard to guide conversion of HMI screens and PLC communications to new HMI infrastructure
  - Developing a formal “Alarm Philosophy” (ISA-18.2) is currently being discussed

Case Study #2 – City of Hamilton

Water / Wastewater Utility for city of 520,000

- **2000 Last release of 3.x series of previous city water/wastewater SCADA standards released**
- 2006 Existing city RPU technology nearing end of life and planned obsolescence

- **2007 Project to begin development of SCADA Master Plan, Standards & Implementation begins**
- 2008-2009 Detailed Discovery, Workshops, and Needs Analysis undertaken to develop standards
- **2009 First version of 4.0 SCADA Standards released, including standardized PLC/HMI code blocks**
- 2009 Pilot projects undertaken to test out new standards and integrated control philosophy

- **2010 (Nov) Version 4.1 of standards released incorporating lessons learned from pilots**
- **2011 Standards used to design new control panels, server room, and plant network**
  - for implementation during 2011-2014; implementation currently underway

- 2011 (May) Ver. 4.2 of standards released incorporating improvements identified through ongoing projects
- **2011 Council approves using standardized key PLC/HMI hardware; paving the way for a standardized SCADA system**
- 2011 (Dec) SCADA upgrades designed and put out to tender for critical outstations
- 2012 (Sept) SCADA upgrades designed and put out to tender for remaining legacy outstations
- 2012 (ongoing) SCADA upgrades being designed for water & wastewater plants for tender in early-2013

Case Study #3 – Halton Region Water / Wastewater

Water/Wastewater Utility for region of 500,000 people

- Pre-1998 SCADA design and programming done on a per project basis
- 1997-1998 Development of first SCADA Master plan

- **1998 First SCADA Master Plan released**
- 1999-2000 Master plan used to guide "Y2K" upgrade of all HMIs
  - Project was used to develop the SCADA Standards for implementing components of the SCADA Master Plan
- **2001 First version of SCADA Standards released – PLC & HMI programming**
  - HMI software, HMI screen design, PLC code, standardized HMI toolkits and PLC code blocks
- **2002 Started Development SCADA Standards for control panels, field wiring, pump control circuits**
- 2003-2005 Incremental Additions to SCADA Master Plan
  - SCADA reporting, data management, alarming, energy management, asset tracking, control system redundancy, planned software upgrades, disaster recovery, WAN network design

- **2007 SCADA Master Plan update released**
- 2009 General update to SCADA Standards, including specific details for sewage lift stations
- 2011 Reviewed the use of terminal services (remote desktop) as part of ongoing technology review
- 2012 Continuing to regularly update SCADA Master Plan and SCADA Standards

TAKE AWAY POINTS

Summary – Automation Master Planning

- Start by developing a **Automation Master Plan** to guide the way forward
- The Automation Master plan will form the vision for your standardization program

- Developing the master plan and standards documents will require:
  - An initial time investment
  - Support from management and procurement departments
  - Active participation from users: Operators, Maintenance, Engineering, etc.

- Develop **Facility Automation Standards** to support and enforce the Automation Master Plan
- Tailor the level of detail in your standards to the size and needs of your facilities
- Regularly review/update your master plan and standards as “living documents”

- Once developed, use your standards for all capital projects – both upgrades and new builds

- Use your Automation Master Plan to develop a prioritized and strategic timeline for upgrades

- **Make standardization work for you:**

  save design time, streamline integration, increase usability, boost reliability
  simply maintenance, reduce training costs, save on overall life-cycle costs

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