Owner Operator Guide to Emerging Smart Technology

Fluor’s SmartPlant Implementation Initiative

By: John Dressel
Process Measurement and Control Technologies are Increasing and Emerging at an alarming rate

New and Emerging Smart Technologies:
- Chip Sets = Smart = Data
- HART Protocol = Smart = Data
- Fieldbus = Digital = Data
- Wireless = Networks = Data
- Web Centric = Cloud = Data
- Networks = Systems = Data
- Bluetooth = Connectivity = Data
- Remote I/O = Networks = Data
- Electronic Marshalling = Data
The Emergence of Data Centric Instrument Systems has caused the decline of Technologies

Outdated Instrument Technologies:

- Pneumatic Instrumentation
- 4-20 mA Analog Signals
- Hardware Based BPCS
- Dedicated DCS Consoles
- I/O Buildings and Rooms
- Multi-core Homerun Cables
- Switch and Hard Wired Logic
- Discrete Field Switches
Obstacles to Smart Instrumentation

♦ Outdated or Ignored Instrument Standards
♦ Capability of CAE Software to Document New Tech
♦ Under Trained or Uninformed Engineering User Base
♦ Owner Operator Acceptance of New Technologies
♦ Obstructive Paradigms to New Tech:
  – “This is the way we’ve always done it”
  – “It is not secure enough for our use”
  – “We don’t know how to maintain it”
  – “This technology is too complex”
  – “This technology is not proven”
  – “It will confuse our Operators”
Standards are continually being Updated:

- ISA-95/IEC 62264 Control System Integration (2005)
- ISA-88/IEC 61512 Batch Control (2010)
- ISO 26262/IEC 61508 Functional Safety Equipment (2011)

Plants Engineered, Built or Updated after the latest release of a standard should Follow or Update to the latest Standard as “Best Practice”
Updated Instrument Standards

♦ ANSI/ISA-5.1-2009 Instrumentation Symbols and Identification has significant changes over the previous version ISA-5.1-1984 (R1992)
♦ This standard has been updated to include New and Evolving Instrument Technology, Control Systems and Computer Networks
♦ Instrument Types and Naming Conventions as defined on the P&ID dictate the Instrument Types used by SmartPlant Instrumentation
– Analog
– Application Software
– BPCS
– Communications
– Computer Control System
– Data Link
– Detector
– Discrete Signal
– Field Instrument
– Hardware
– HLCS
– Software
Identification letters table

- C – “Close” Modifier
- D – “Deviation” Modifier
- G – “Gauge” Function
- O – “Open” Modifier
- R – “Run” Modifier
- S – “Stop” Modifier
- W – “Probe” Function
- X – “Accessory Device”
- Z – “SIS” Variable Modifier

### Table 4.1 — Identification letters

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure/Unit Variable</td>
<td>Variable Modifier (1)</td>
<td>Residual/Passive Function</td>
<td>Output/Actuating Function</td>
<td>Function Modifier</td>
</tr>
<tr>
<td>Analysis</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>B</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Distance</td>
<td>C</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Time</td>
<td>D</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Voltage</td>
<td>E</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Flow, Flow Rate</td>
<td>F</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Pressure</td>
<td>G</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Quantity</td>
<td>H</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Relative</td>
<td>I</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Time Schedule</td>
<td>J</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Unit</td>
<td>K</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Speed, Frequency</td>
<td>L</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Temperature</td>
<td>M</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Weight, Force</td>
<td>N</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Unclassified</td>
<td>O</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Event, State, Presence</td>
<td>P</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>Position, Dimension</td>
<td>Q</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>R</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>S</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>T</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>U</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>V</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>W</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>X</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>Y</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
<tr>
<td>User’s Choice</td>
<td>Z</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
<td>User’s Choice (3)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses refer to the corresponding explanatory notes in Clause 6.4.
ANSI/ISA-5.1-2009 – Table 5.1.1

♦ Column A - DCS - BPCS
  - Primary Shared Control System (DCS)
  - Basic Process Control System (BPCS)

♦ Column B - PLC - SIS
  - Alternate Shared Control System (PLC).
  - Safety Instrumented System (SIS)

♦ Column C - Software
  - Computer Functions and Software
  - High Level Control System (HLCS)

♦ Column D - Hardware
  - Discrete Primary Elements
  - Discrete Transmitters
  - Discrete Switches and Indicators
  - Discrete Transponders and Relays
  - Discrete Hardware Controllers
  - Discrete Final Control Elements
  - Discrete Control Valves
Table 5.2 is a new table for Measurement Notations and has added several New Technology Functions.

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Flow</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR = Excess air</td>
<td>CFR = Constant flow regulator</td>
<td>CAP = Capacitance</td>
</tr>
<tr>
<td>CO = Carbon monoxide</td>
<td>CONE = Cone</td>
<td>dp = Differential pressure</td>
</tr>
<tr>
<td>CO2 = Carbon dioxide</td>
<td>COR = Conic</td>
<td>DI = Dielectric constant</td>
</tr>
<tr>
<td>COL = Color</td>
<td>DOP = Doppler</td>
<td>DP = Differential pressure</td>
</tr>
<tr>
<td>COMB = Combustibles</td>
<td>DSON = Doppler sonic</td>
<td></td>
</tr>
<tr>
<td>COND = Conductivity</td>
<td>FLN = Flow nozzle</td>
<td></td>
</tr>
<tr>
<td>DEN = Density</td>
<td>FLT = Flow tube</td>
<td></td>
</tr>
<tr>
<td>GC = Gas chromatograph</td>
<td>LAM = Laminar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAG = Magnetic</td>
<td></td>
</tr>
<tr>
<td>H2O = Water</td>
<td>OP = Orifice plate</td>
<td>MAG = Magnetic</td>
</tr>
<tr>
<td>H2S = Hydrogen sulfide</td>
<td>OP-C = Corner taps</td>
<td>RES = Resistance</td>
</tr>
<tr>
<td>HUM = Humidity</td>
<td>OP-CQ = Circle quadrant</td>
<td>RAD = Radar</td>
</tr>
<tr>
<td>IR = Infrared</td>
<td>OP-E = Eccentric</td>
<td>NUC = Nuclear</td>
</tr>
<tr>
<td>LC = Liquid chromatograph</td>
<td>OP-FT = Flange taps</td>
<td>US = Ultrasonic</td>
</tr>
<tr>
<td>MOIST = Moisture</td>
<td>OP-MH = Multi-hole</td>
<td></td>
</tr>
<tr>
<td>MS = Mass spectrometer</td>
<td>TAR = Target</td>
<td></td>
</tr>
<tr>
<td>NIR = Near infrared</td>
<td>THER = Thermal</td>
<td></td>
</tr>
<tr>
<td>TDL = Tunable diode laser</td>
<td>VENT = Venturi tube</td>
<td></td>
</tr>
<tr>
<td>UV = Ultraviolet</td>
<td>VOR = Vortex Shedding</td>
<td></td>
</tr>
<tr>
<td>VIS = Visible light</td>
<td>WDG = Wedge</td>
<td></td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses refer to explanatory notes in Clause 5.3.2.
Primary element symbols with several new symbols for special Orifices and Measurement Technology

<table>
<thead>
<tr>
<th>No</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1  | ![Symbol](image1) | Conductivity, moisture, etc.  
Single element sensing probe. |
| 2  | ![Symbol](image2) | pH, ORP, etc.  
Dual element sensing probe. |
| 3  | ![Symbol](image3) | Fiberoptic sensing probe. |
| 8  | ![Symbol](image4) | Concentric circle orifice plate.  
Restriction orifice. |
| 9  | ![Symbol](image5) | Eccentric circle orifice plate. |
| 10 | ![Symbol](image6) | Circle quadrant orifice plate. |
| 11 | ![Symbol](image7) | Multi-hole orifice plate  
Generic venturi tube, flow nozzle, or flow tube. |
Added Line symbols with new symbols and signal types for Wireless, Fieldbus, Smart and Serial Communications

Table 5.3.2 — Line symbols: instrument-to-instrument connections

<table>
<thead>
<tr>
<th>No</th>
<th>Symbol</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>IA may be replaced by PA (plant air), NS (nitrogen), or GS (any gas supply). Indicate supply pressure as required, e.g., PA-70 kPa, NS-150 psig, etc.</td>
</tr>
<tr>
<td>2</td>
<td>ES</td>
<td>Instrument electric power supply. Indicate voltage and type as required, e.g. ES-220 Vac. ES may be replaced by 24 Vdc, 120 Vac, etc.</td>
</tr>
<tr>
<td>3</td>
<td>a)</td>
<td>Unguided electromagnetic signals, light, radiation, radio, sound, wireless, etc. Wireless instrumentation signal. Wireless communication link.</td>
</tr>
<tr>
<td></td>
<td>b)</td>
<td>Unguided electromagnetic signals, light, radiation, radio, sound, wireless, etc. Wireless communication link.</td>
</tr>
<tr>
<td>4</td>
<td>——</td>
<td>Communication link and system bus, between devices and functions of a shared display, shared control system. DCS, PLC, or PC communication link and system bus.</td>
</tr>
<tr>
<td>5</td>
<td>——</td>
<td>Communication link or bus connecting two or more independent microprocessor or computer-based systems. DCS-to-DCS, DCS-to-PLC, PLC-to-PC, DCS-to-Fieldbus, etc. connections.</td>
</tr>
<tr>
<td>6</td>
<td>——</td>
<td>Communication link and system bus, between devices and functions of a fieldbus system. Link from and to “intelligent” devices.</td>
</tr>
<tr>
<td>7</td>
<td>——</td>
<td>Communication link between a device and a remote calibration adjustment device or system. Link from and to “smart” devices.</td>
</tr>
</tbody>
</table>
Final control element actuator symbols with new Valves with positioners and partial stroke testing device symbols

<table>
<thead>
<tr>
<th>No</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1  | ![Symbol](image) | Generic actuator.  
|    |        | Spring-diaphragm actuator.                       |
| 2  | ![Symbol](image) | Spring-diaphragm actuator with positioner.       |
| 3  | ![Symbol](image) | Pressure-balanced diaphragm actuator.            |
| 15 | ![Symbol](image) | Actuator with manual actuated partial stroke test device. |
| 16 | ![Symbol](image) | Actuator with remote actuated partial stroke test device. |
| 17 | ![Symbol](image) | Automatic reset on-off solenoid actuator.  
|    |        | Non-latching on-off solenoid actuator.          |
Annex A has expanded Tables for Allowable Loop, Tag & succeeding letter combinations for instrument functions

Added Function modifiers PF = Ratio, PQ = Total, PS = Safety & PZ = SIS

ISA now recognizes over unique 1000 Instrument Type identifiers
Annex B, “Graphic symbol guidelines” (Informative), is a new informative clause that replaces the examples formerly given in Clause 6, “Drawings,” to provide some limited assistance in the application of the symbols in Clause 5. These examples are more generic and limited in nature than the previous ANSI/ISA-5.1-1984 (R 1992).

Note the use of the “FC” Field Controller for Fieldbus VFD.
Documenting New Tech on Smart P&ID

♦ The P&ID Defines all Elements of the Technology
  – Use the Latest Symbols (ANSI/ISA-5.1-2009)
  – Show Every Tag and Valve (No “Implied” Tags)
  – Show the Signal Type and Technology of Every Element
  – Be Mindful of the Smart P&ID Data Integrity and Quality
  – Expect and Use Data Integration to other Smart Software
Documenting New Tech with SPI

♦ SmartPlant Instrumentation has the Ability to Document any New Technologies with Minimal Modifications
  – Define New Instrument Types for Emerging Technologies
  – Develop New Spec Forms for New Tech Devices
  – Document Fieldbus and Profibus with the Wiring Module
  – Document Networks using the Telecommunications Module
How Engineers Cope with New Tech

♦ Because Emerging Technologies are developing at such a rapid pace it is necessary for CS Engineers to:
  – Get Additional Training on New or Emerging Technologies
  – Attend User and Vendor Conferences and Seminars
  – Attend Lunch & Learns on New Products and Technologies
  – Use Knowledge Management Systems for Collaboration
  – Become Subject Mater Experts centered on New Tech
  – Work directly with Vendors to develop New Technology
  – Join Standards Organizations and Serve on Committees
♦ Engineers need to bring Answers about New Technology to the Owner Operator Clients – Not Questions!
♦ When it comes to New and Emerging Technologies - “The Customer is Not Always Right!”

- It is the Engineering Companies responsibility to keep up with New Technologies and Advise Clients Accordingly
- Operating Companies hire EPC’s to do the engineering expecting the companies to engage current Best Practices
- Clinging to Existing Technologies will Create Built-in Obsolescence when Developing New or Updated Facilities
- Owner Operators and Engineering Companies Share the Risk when the latest Standards are not followed
Accepting New or Emerging Technology may require a Paradigm Shift by the Owner Operator Client

- **Self Knowledge** – Educate Yourself about New Tech
- **Interaction** – Work with Engineers and Vendors on New Tech
- **Adaptive Thinking** – Accept Change when Using New Tech
- **Digital Literacies** – Embrace Data Centric Instrumentation
Owner Operator Acceptance of New Tech

♦ Paradigm - “This is the way we’ve always done it”
  – Most Existing Plants are more than 10 Years Old and the Measurement and Control Technology is long outdated
  – Digital Technologies are more accurate and dependable
  – Digital Technologies are more efficient than 4-20 mA Analog and high demand instrument air supplied technologies
  – Emerging Technologies of today will be “the way we’ve always done it” of the future

FLUOR®
♦ Paradigm - “It is not secure enough for our use”

– Cyber Security and Digital Information networks are much more secure than previous generation technology

– Most concern about security is around wireless and networks:

• WirelessHART and ISA100.11a meets the Federal Information Processing Standard 197 (FIPS-179) and both are AES-128 encryption (NIST/IEEE 802.15.4) compliant

• Industrial Automation and Control Systems Network manufactures, Integrators and end-users comply with the ISA/IEC-62443 (Formerly ISA-99) set of Standard Documents

OH WOW! PARADIGM SHIFT!
Paradigm - “We don’t know how to maintain it”

- Almost all obsolete, and difficult-to-maintain analog technology for Measurement and Control systems in the U.S. have been replaced with digital systems over the last 10 to 20 years.
- The advantages of digital technology is improved diagnostics capability and system reliability requiring less maintenance.
- Some digital instrumentation has been in place in most installations for almost 20 years and current calibration and maintenance equipment are designed to be used with it.
Paradigm - “This technology is too complex”

- Digital Instruments have fewer moving parts and are simpler to read, diagnose and access than analog instruments
- The use of computers and standard networks allow access to a wide variety of off the shelf components
- Every major media in use today is based on Digital Technology (Communications, Computing, Television, Recording, Measurement and Control)
Paradigm - “This technology is not proven”
– Current Standards support Digital Technology
– Current Best Practices are based on Latest Tech
– Digital Instrument Systems are Proven in Use
– Equipment is Certified as Fit for Purpose
– Technology must be Competitive to Market
Paradigm - “It will confuse our Operators”

- Operators have more information at their disposal when using a modern HART or Bus based digital control system
- New DCS, BPCS and HMI advances simplify operations
- The Equipment and Technology used to gather and connect the components of a modern instrument system are transparent to the Operators
Instrument Technological Revolution

Digital Measurement and Control Technology is the New Standard

THINK SMART!

Think SmartPlant!

Think SmartPlant Instrumentation!

Questions?