Smart Instrumentation Data Management

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Control Systems Fellow

Smart Instrumentation Data Management

Garbage In – Garbage Out

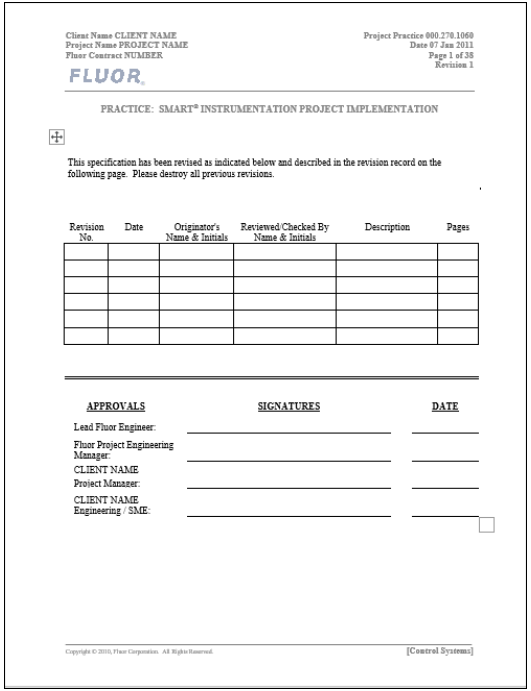
- Managing Data with Governing Documents
- Managing Data with Naming Conventions
- Managing Data with Instrument Types
- Managing Data with Automation
- Managing Inconsistent Data Values
- Managing Data with Null Values
- Managing Spec Sheet Data
- Managing Process Module Data
- Managing Custom Defined Fields Data
- Managing Smart Instrumentation Data Validation

Smart Instrumentation Garbage Data

- "**Garbage In, Garbage Out**" - used to express the idea that in a relational database, incorrect or poor-quality input will always produce faulty output.
- In a Smart Instrument data dictionary, every Table and Trigger has a specific purpose and is intended to contain data that is relevant to that purpose
- Incorrect data can also affect the performance of the database
- Examples of Garbage in a Smart Instrumentation database:
  - Unstructured or Duplicate Key values in primary tables
  - Inconsistent or Dummy data not fit to purpose of Fields
  - Data that violates the purpose of a “Null” Data value
  - Duplicating fields in the data dictionary with User Defined Fields
  - Graphics, Narratives or Extensive Notes used in place of valid data

Managing Smart Instrumentation Governing Documents

- **Data Management with Implementation Specification**
  - Define Smart Instrumentation Project Scope, Principals, Definitions and Deliverables
  - Define or Reference Plant Hierarchy
  - Define or Reference Naming Conventions
  - Define Smart Instrument Modules usage
  - Define Instrument Types Profile Content
  - Define Specification Sheet Library
  - Define Primary Tables Contents
  - Define Integration to Vendor Software or SmartPlant Foundation



Client Name CLIENT NAME
Project Name PROJECT NAME
Fluor Contract NUMBER

Project Practice 000.270.1060
Date 07 Jan 2011
Page 1 of 38
Revision 1

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PRACTICE: SMART® INSTRUMENTATION PROJECT IMPLEMENTATION

This specification has been revised as indicated below and described in the revision record on the following page. Please destroy all previous revisions.

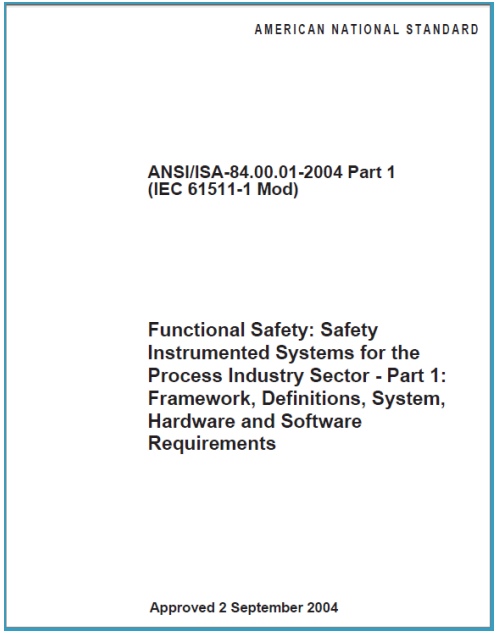
Revision No.	Date	Originator's Name & Initials	Reviewed/Checked By Name & Initials	Description	Pages

APPROVALS	SIGNATURES	DATE
Lead Fluor Engineer:		
Fluor Project Engineering Manager:		
CLIENT NAME Project Manager:		
CLIENT NAME Engineering / SME:		

[Control Systems]

Managing Smart Instrumentation Governing Documents

- **Data Management with Reference Governing Documents**
- Implementation Procedures (Referenced Documents)
  - User Guides for Data entry
  - Training Materials
- Implementation Practices (Referenced Documents)
  - Industry Standards
  - Client Specifications
- Hexagon's Smart Instrumentation Documentation
  - Smart Instrumentation Users Guides.pdf
  - Smart Instrumentation Tutorials.pdf


AMERICAN NATIONAL STANDARD

ANSI/ISA-84.00.01-2004 Part 1
(IEC 61511-1 Mod)

Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements

Approved 2 September 2004

Managing Smart Instrument Naming Conventions

- There are 39 definable Naming Conventions in Smart Instrumentation
- The most important naming conventions are the Loop and Instrument Tag (Tag Class)
  - The Loop naming convention defines the Process Function and Numeric sequence
  - The Instrument Tag (Tag Class) naming convention expands the Loop naming with Instrument Function and Tag Class defines wiring technology tables
- Keep Naming Conventions simple – Tags can have additional data (Unit Numbers, Etc.) but information like Equipment Numbers, Location Codes are not recommended

Segment Category	Seq.	Separator	Segment	Start	Length
Unit	1		UNIT NUMBER	1	2
Instrument Type	2		INSTRUMENT TYPE	1	5
Tag Number	3	-	EQUIPMENT	1	2
Tag Number	4	-	COMPONENT NUMBER	1	4
Tag Number	5		COMPONENT SUFFIX	1	3

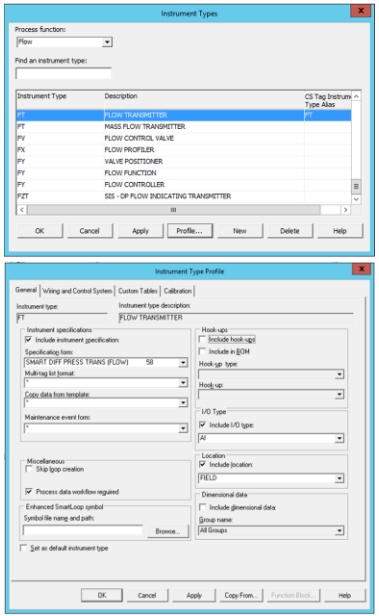
Managing Smart Instrument Naming Conventions

- Best practice is to use only “Instrument (Conventional)” for Instrument Tags
- The Loop and Tag naming conventions need to be consistent across all applications
- Additional Naming Conventions can also be assigned for documents, cabinets, cables and equipment for data consistency

Analyzer Component	Document Number (Panel-Strip Report)	Instrument (Profibus DP)
Analyzer Stream	Document Number (Process Data)	Instrument (Profibus PA)
Cabinet	Electrical Signal Tag	Instrument (Telecom)
Control System Tag	Foundation / Profibus PA Virtual Tag	Junction Box
DCS	Functional Requirement	Loop
Device Cable	HART Signal	Marshaling Rack
Device Panel	I/O Card	PLC
Document Number (Calculation)	I/O Termination	RACK
Document Number (DDP)	Instrument (Conventional)	Soft Tag
Document Number (Instrument Specs)	Instrument (Foundation Fieldbus)	Test Equipment
Document Number (Loop Drawing)	Instrument (HART)	Wiring Equipment
Document Number (Loop Specs)		

Managing Instrument Type Profile Data

- **The Instrument Type Profile** defines the automation functions and how data is distributed in the Smart Instrument database
- When an instrument is added to the database, or the Profiles are launched the following actions will happen if the Profile Data is populated:
  - An Instrument Spec sheet is created and populated from a Spec Sheet Template if a Template is defined
  - A Process Datasheet is created in the proper Process Function assigned to the Instrument Type if “Process data workflow required” is set
  - The I/O Type and Location are assigned
  - The Wiring Device Panel and Terminals are created, and the Instrument Cable is created and connected to the Device Panel
  - Other associations including Custom Tables, Hook-ups, Dimensional Data for Piping and Loop Symbols can be initialized



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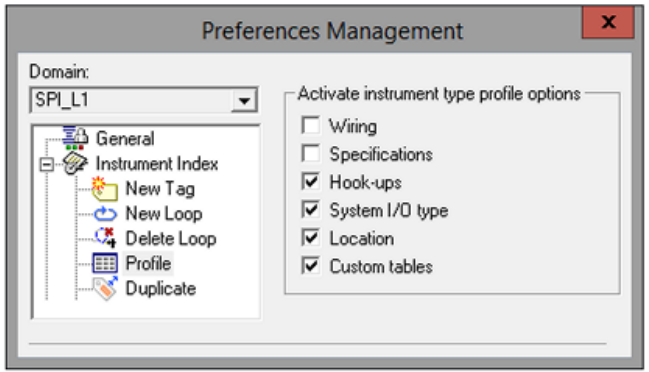
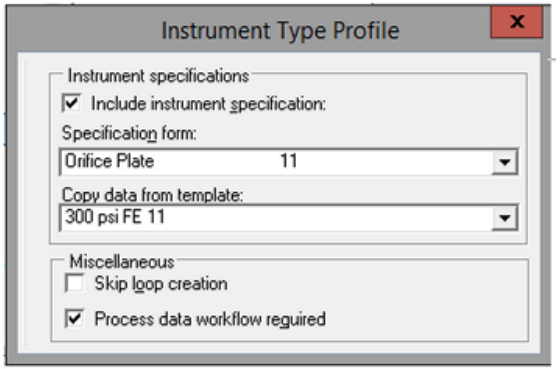
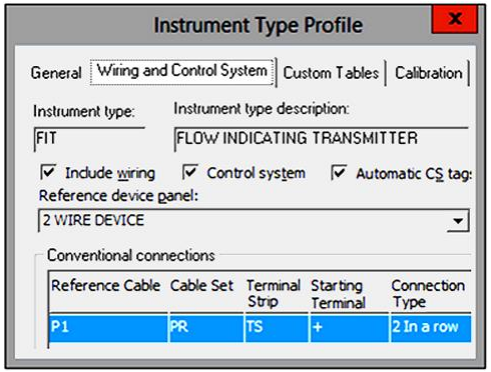
Managing Smart Instrumentation Automation

- In **Preference Management** users can deactivate Wiring and Specifications automation until Specification Templates and wiring connections are properly defined and configured
- Each Instrument Type Profile should define the Specification Form and Template if created
- Every Instrument that touches process should have “Process data workflow required” set on
- Every instrument that has Wiring should have the “Wiring and Control System” configured







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Managing Smart Instrumentation Inconsistent Data

- **Data Consistency** is essential for a relational database and assuring the quality of data in Smart Instrumentation
- Methods for managing data consistency includes:
  - Minimize the number of Instrument Type Profiles and configure each for data consistency
  - Using User Defined Tables and User Defined Field Pick Lists for selection of consistent data
  - Minimize the content of Primary Tables to only data necessary for the project
  - Configure as many Naming Conventions as possible to minimize ad hoc data entry in key fields
  - Define abbreviations in the Implementation Specification for consistence data entry
  - Train users to use loop and specification templates when expanding data and to duplicate data

Loop Name	Tag Number	P&ID Number		Line Number	Equipment Number	I/O Type	Manufacture	Model
*	103-PI -0191	WH-M-103-146	FIELD	*	3-103-RW-P-0527	*	TBD	I3-RW-P-052
103-P-0195	103-PI -0195	WH-M-103-146	DCS	3-12"-RB-20411-ND-N	3-103-RW-P-0528	SOFT	N/A	N/A
*	103-PI -0197	*	FIELD	*	3-103-RW-P-0528	*	TBD	TBD
103-F-0178	103-PIT -0178A	WH-M-103-146	DCS	3-42"-RW-20221-NA-N	*	AI	ROSEMOUNT	3051S1TG4A3E11A1JB4E5M5T1

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Managing Smart Instrumentation Inconsistent Data

- **"Data fit the Purpose"** – every data field column and table in Smart Instrumentation has a purpose as defined by the Table or Field name
- Common errors in data placed in the wrong Table or Column are:
  - Mixing Tag Class, I/O Types and Signal Types
  - Difference between Manufacture Model and Catalog numbers
  - Assigning Soft Tag numbers to Control System Tags or wiring tables (e.g. cable, I/O)
  - Assigning both a Line Number and Equipment number to a Tag
  - Not filling in Key Field Data like P&ID Number or Loop Number

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103-F-0178	103-PIT -0178A	WH-M-103-146	DCS	3-42"-RW-20221-NA-N	*	AI	ROSEMOUNT	305151TG4A3E11A1JB4E5M5T1

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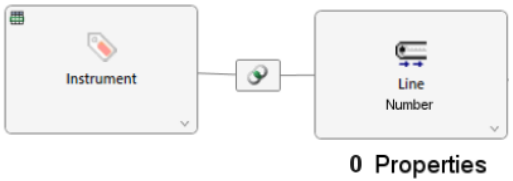
Managing Smart Instrumentation Null Values

- **“Purpose of a ‘NULL’ value”** – A field with a NULL value is a field with no value. It is very important to understand that a NULL value is different than a zero value or a field that contains any Data
- In a Relational Database a “**NULL**” is not a valid object so there is no memory allocated for it
- In a Relational Database a “**NULL**” value stops a query from engaging additional Foreign Keys
- Any value including “**space**” or “**–**” or “**NA**” in a Key field allocates memory equal to the size of all fields in the table and continues thru the triggers for all additional Foreign Keys in all linked tables
- A ‘**NULL**” value as the Line Number Key Field will stop the query and no memory is allocated in tables linked to the Line Number table



IF LINE NUMBER 'NULL'

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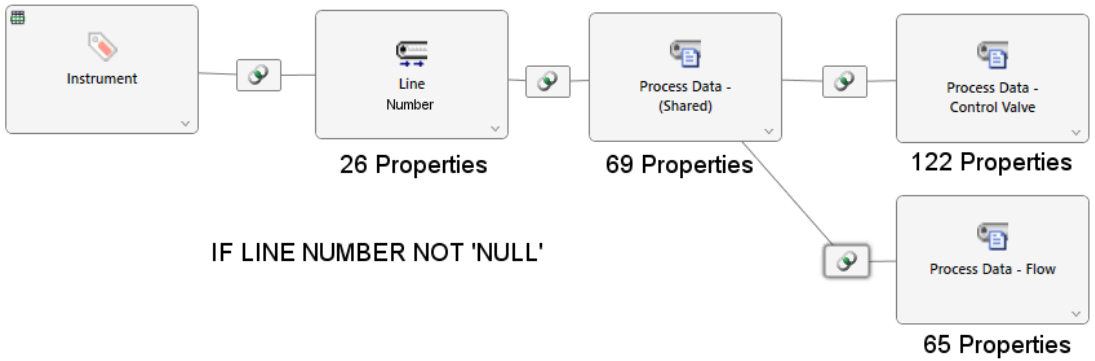
- A ‘**N/A**” or “**–**” value as the Line Number Key Field will act like a real Line number and will allocate memory for all tables linked to the Line Number table



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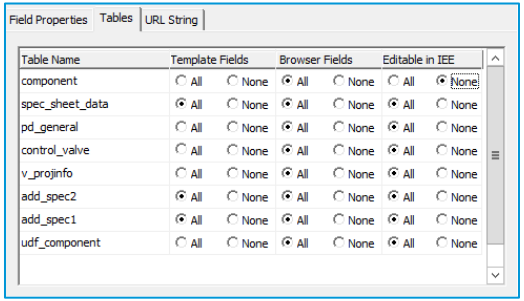
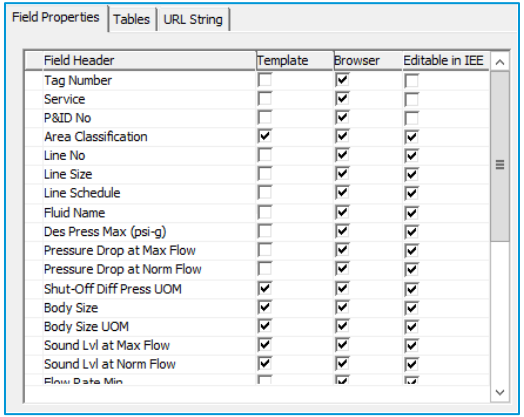
Manage Smart Instrument Spec Sheet Data

- **The Instrument Specification Form (Data Sheet)**
  - Form for each Engineered Instrument Type
  - Data from Index and Line table
  - Data from the Process Function
  - Most of the Form are Spec User Defined Fields
- Spec Forms are one place where garbage data seems to gravitate
- Without a structured data dictionary, it is easy to place irrelevant or incorrect data on a Spec Form
- There is a tendency to overuse notes on a Spec Form instead of structuring the form to provide data fields for needed information

Manage Smart Instrument Spec Sheet Data

- **The Spec Data Dictionary defines Field Headers and what Fields are editable in the following Modules:**
- **The Instrument Specification Template**
- Select only Spec User Defined fields and fields not unique to a Tag
- Do not select Process or Component fields
- **The Instrument Specification Browser**
- All Spec Fields can be selected for editing in a Browser View
- The Spec DD Field Headers are displayed in the Browser View
- **The Instrument Specification External Editor**
- The External Editor allows third parties to edit spec sheets and import them data back into Smart Instrumentation
- Component and Title data are not included in the External Editor





Smart Instrument Process Function Data

- **The Process Function** defines Tables containing the variables associated to each Instruments sizing and selection requirements:
  - General
  - Flow
  - Level
  - Pressure
  - Temperature
  - Analyzer
  - Control Valve
  - Relief Valve

- Instruments that do not Measure or Control a Process Function are considered General instruments
- Process Data needs to be defined by a process engineer and populated in the process module for Sizing and Selection
- Alarms and Trips are defined as Process Data so elements needing these set points will need to be assigned to the proper function

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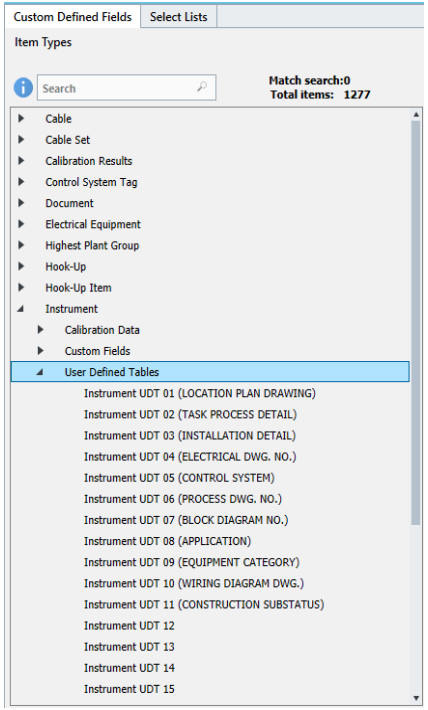
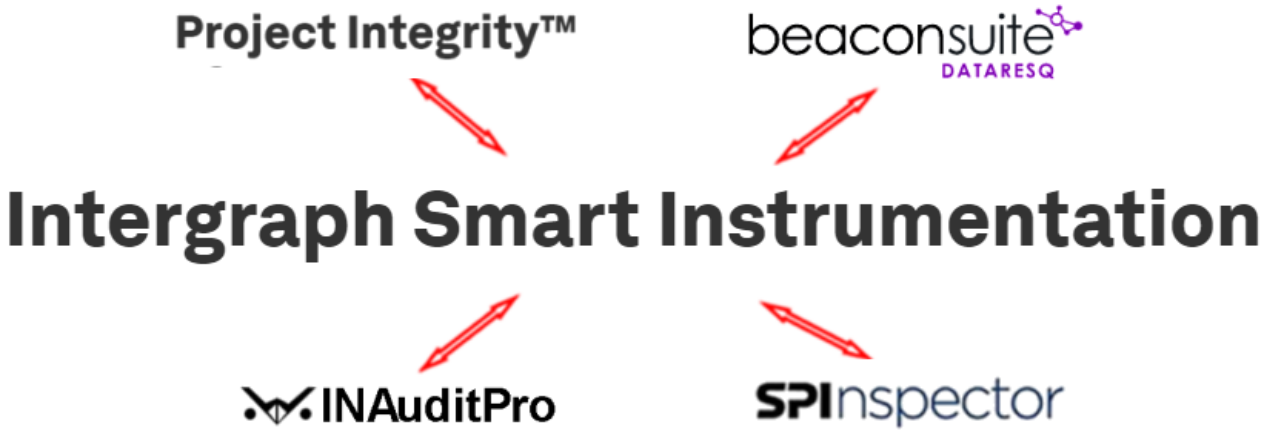
Smart Instrument Custom Defined Fields

- The **Custom Defined Fields** are Provided for all primary Tables
- Custom Fields that are normal in most project database are:
  - **System** – The different Control Systems used in the Project
  - **Plan Drawing** – while the use of Plan drawings are being phased out because of Smart 3D, they are still being used for construction
- Add project specific Fields not included in the data dictionary
- Care should be taken not to repeat data fields already in the Smart Instrumentation Data Dictionary
- The EDE eliminates the need to duplicate data for Custom Reports



Smart Instrument Data Validation

- Smart Instrumentation has several External Validation Software choices
  - Hexagon **Integrity Check Utility** and **Project Integrity**™ data auditor for P&ID, SI and SEL
  - Beaconsuite **DataResq**™ Control for SPI monitors and reports all nonconforming deliverables
  - Mangan **SPInspector**™ examines the SPI database for specific data attribute discrepancies
  - WiseTools **INAuditPro**™ interrogates SPI and generates reports highlighting discrepancies



Smart Instrumentation Data Management

In summery, careful data management is the best way to deal with data validation by:

- Defining the expected quality of data in governing documents
- Configuring Naming conventions and Instrument Type Profiles prior to data entry
- Educating users on proper methods to mitigate inconsistent data and managing Null Values
- Spec Sheet Data Dictionaries and defining Spec Templates in Instrument Type Profiles
- Limiting use of User Defined Fields and Notes
- Using EDE Views to normalize data by instrument type when checking data

“Those who rule data will rule the entire world”

~ Masayoshi Son

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HEXAGON PPM