Modular Procedural Automation

Yokogawa Users Group
October 2012
Modular Procedural Automation (MPA)

- What is MPA?
- Consulting Methodology
- How to select the right tool for the job
- ExaPilot examples
- Centum VP examples
What is MPA?

• “Modular Procedural Automation” (MPA) - Yokogawa’s capability and expertise in providing automated procedures, in accordance with ISA106.

  – A consultative approach by process experts who understand process operations and provide recommendations to automate and improve procedures.

  – Proven methodology that captures, documents and implements procedural knowledge gathered from operational staff

  – It is modular- standardize implementation to increase flexibility, reduce implementation costs, and promote repeatability and reuse.

  – MPA integrates with any existing control system
Capturing Procedural Best Practices

Operator A’s Procedure

Operator B’s Procedure

Operator C’s Procedure

Best-Practices Procedure

- Capture the Best Procedure from all operator inputs
- Combine into a Best Practice Procedure
Original SOP (Standard Operating Procedure)

1. Check base tank level LI 100.PV >= 50%
2. Start pump P-101
3. Check pump status feedback
4. Confirm field operator to open hand valve HV100

Capture Operator Knowledge!
Procedural control- Modularization of code

- Transition from Product mix A to Product mix B
  - Adjust temp SP
  - Ramp gas flow
  - Adjust reflux
  - Reduce Steam
  - Adjust Air Inlet

- Transition from Product mix B to Product mix C
  - Ramp gas flow
  - Adjust temp SP
  - Adjust reflux
  - Adjust temp SP
  - Adjust reflux
  - Adjust Air Inlet
Consulting Site Visit

- Look for opportunities for improvement (major “pain” points)
- Methodologies and templates for:
  - Site visit pre-work
  - Plant walkthrough
  - Interview checklists with
    - Management
    - Operations
    - Other functions
  - Initial review meeting/ on-site report
- Assist in ROI calculations
- Prioritize and recommend best solutions
Tool Selection

• What determines if the MPA application should be implemented in the controller?
  ▪ Fault tolerance (high reliability required?)
  ▪ Safety/environmental risks
  ▪ Execution speed requirements
  ▪ Level of automation available
  ▪ Procedure implementation and lifecycle cost
  ▪ Operating philosophy
  ▪ Incremental implementation/modification of procedures
Yokogawa MPA Tools

- **Unit Instrument Function Block**
  - Within the redundant FCS Controller
  - Based on ISA88 structure (SFC)
  - Supports state-based control
  - Allows the use of modular generic sequences/tags/code
  - Generates operator messages/confirmations/data entry

- **Exapilot**
  - Within the Advisory Computer
  - User-friendly flowcharting
  - Allows for modular sub-procedures
  - Capable of manipulating instruments
  - Generates operator messages/confirmations/data entry
  - Works with any control system (OPC)
Basic MPA Architecture

- ExaPILOT Procedure Builder
- E-NET
- MPA Server & Historian
- Exa OPC Server
- HIS A
- HIS B
- HIS C
- Integrated Operator Display

- Unit Instruments
  - FCS01
  - FCS02

Copyright © Yokogawa Electric Corporation October 2012
Design Components

Three models identified, Physical, Procedure, and Implementation

ISA-106 Physical Model
- Enterprise
- Site
- iPlant
- iPlant Area
- Unit
- Equipment
- Device

ISA-106 Procedure Requirements Model
- Enterprise Procedure Requirements
- Site Procedure Requirements
- Plant Procedure Requirements
- Plant Area Procedure Requirements
- Unit Procedure Requirements
- Equipment Procedure Requirements
- Device Procedure Requirements

ISA-106 Procedure Implementation Model
- Site Implementation Modules
- Plant Implementation Modules
- Plant Area Implementation Modules
- Unit Implementation Modules
- Equipment Implementation Modules
- Control Implementation Modules

ISA-106 primarily deals with these objects.
Ethylene Furnace Example

Plant Area

Unit

- Furnace 1
- Furnace 2
- Furnace 3
- Furnace 4
- Furnace 5
Ethylene Furnace Example

Plant Area

Unit

Equipment

Device

Air & Fuel Input

Discharge

QUENCH TOWER

DECOKE DRUM

Heater

Yokogawa Users Group
Copyright © Yokogawa Electric Corporation
October 2012

vigilantplant: The clear path to operational excellence

- 13 -
State Transition Diagram

<table>
<thead>
<tr>
<th>State</th>
<th>Available Commands</th>
<th>Operator-Initiated?</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracking</td>
<td>Decoke</td>
<td>Yes</td>
<td>The furnace is in full production. Coking deposits are being monitored.</td>
</tr>
<tr>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Decoking</td>
<td>Standby</td>
<td>No</td>
<td>Coking deposits are being removed from the coils. At the end of process, the status is automatically changed to Standby. If an abnormal condition occurs, the status is automatically changed to Pause.</td>
</tr>
<tr>
<td></td>
<td>Pause</td>
<td>No/Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Stopped</td>
<td>Crack</td>
<td>Yes</td>
<td>Furnace is taken out of service for maintenance. Cracking or Decoking can be selected by the operator.</td>
</tr>
<tr>
<td></td>
<td>Decoke</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Standby</td>
<td>Crack</td>
<td>Yes</td>
<td>Furnace is ready to be transitioned into Cracking from Decoking.</td>
</tr>
<tr>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Paused</td>
<td>Decoke</td>
<td>Yes</td>
<td>Operator can pause the Decoking at any time and resume it.</td>
</tr>
</tbody>
</table>
Map Procedures to States

- Cracking
  - Initialization
    - Phase 1
    - Phase 2
    - Phase 3
  - Paused
  - Standby
  - Stopped

- Cracking Procedure
- Decoking Procedure
- Pause Procedure
- Standby Procedure
- Stopping Procedure
Exapilot - Interface with Graphics

Advisory Computer sends an operator a confirmation message for a step before proceeding with automated procedural steps.
1  * PHASE 3
2  ************************************************************
3  $$.FNAME = "PHASE 3"
4  ************************************************************
5  SET PHASE3 Set value for XOT & COT
6  $$$.STEP = 15
7  $$$.STBNAM = "SET SV: COTXOT"
8  [GLOT.MODE.SV ="AUT", $$$.PHXOT3SE]
9  [GLOT.MODE.SV ="AUT", $$$.PH3COTSE]
10
11  SET PHASE3 Set value & Ramp rate for Ar flow and start Phase 3 Time
12  $$$.STEP = $$$.STEP + 1
13  $$$.STBNAM = "SET SV: AIRFLW"
14  GAIRSET.F01 = $$$.PH3AIRMAX
15  GAIRSET.F02 = $$$.PH3AIRMAX
16
17  [STMB.OP.CL.PH = TMCOOT, TMSTAT$$$.PHTIME]
18  iRamp = $$$.PHRATE
19
20  while($$.TIME.BSTS <> "STOP")
21    If ( GLOT.EV < $$$.PH3COOXM ) then
22       iRamp = iRamp*0.98
Example of Unit-based Procedure:

• Preparation for Startup of Train XYZ
  – Utilities Check (check of utilities valves, instrumentation, etc.)
  – Reaction Process (start of circulation, heating, flow check, etc.)
  – Purification Process (manual valves open check, etc.)
  – By-product Recovery Process (temperature checks, etc.)
  – Separation Process (scrubber circulation, pH check, etc.)

• Possible States of the Train XYZ
  • WAIT
  • READY FOR START
  • START-UP
  • RUNNING
  • STOP
Unit Instruments - Generic Functions

The clear path to operational excellence
MPA - Where to Start?

- Look for opportunities - Any time one needs to move from one state to another that requires a discrete set of activities
  - Startups / Shutdowns
  - Crude Switches
  - Grade Changes
  - Cleaning / Regeneration

- Find Justifications based on:
  - Safety & Exposure
  - Productivity
  - Cost Efficiency
  - Knowledge Capture

- Start Small
  - Use the best tool for the job
  - Get users involved (buy-in and better results)
  - Create Templates
Modular Procedural Automation - Applications

- Wednesday 10-31-2012, Technology Session Track 2

  - Wayne Hawkins, Chevron
    “Modular Procedural Automation in Gulf of Mexico Deepwater Operations”

  - Zahra Kerkan, Shell
    “Modular Design Approach to Subsea MCS”

  - Exhibit Area – Exapilot Demo
Modular Procedural Automation - Summary

• Consulting Methodology
  – Capture best practices
  – Modular

• Available Today

• ISA-106 Upcoming Standard
  – Systematic, model-based approach

• Tool Selection
  – Exapilot
  – Unit Instrument Function Block
Questions?

Thank you.