Developing DCS Specifications for Control System Modernization

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Presentation Agenda

1. Presentation Objectives
2. Pros and Cons of a Migration Project
3. Overview of the Project Requirements Process
4. Overview of a DCS Configuration Specification
5. Vendor Quoting Process
6. Functional Specification
There are 6 key messages (objectives) in this presentation

1. Provide an overview of the requirements process. (Slide 4)
2. Principle Requirements need to be developed with upper management early in the project (Slide 5)
3. The DCS Configuration Specification is the key document to address the fundamental challenge in obtaining comparable quotes, while minimize exposure to scope changes without developing a functional specification (Slide 8-9)
4. Provide a table of contents and content examples for a DCS Configuration Specification (Slides 10-12)
5. The Vendor quoting process uses summary data, averages & statistics to generate a proposal. The DCS Configuration & Service Specification compliments this process (Slide 13)
6. In order to ensure the generation of an effective functional specification, the document contents and approach needs to be specified (Slide 14-16)
A Migration project has advantages over a greenfield facility.

Advantages
- Instrumentation is installed and working
- Process Control Methodology and sequences are known, proven and working
- Existing software can be used as process definition

Disadvantages
- Two Existing technologies must run side by side – gateways must be defined
- IO Migration is the primary concern
- Cutover time must be minimized

These items contribute the majority of issues encountered in a new installation.
Developing requirements is an evolutionary process that can be separated into two phases.

**Proposal Phase**
- Principle Requirements
- DCS Qualification Requirements
- Configuration & Service Specification (CSS)
- Generate a Quote
- Vendor Selection

*This presentation focus is on the proposal phase*

**Project Execution Phase**
- Functional Specification
- Design Specification
- Scope Changes

Feed Study
Principle Requirements need to be developed with upper management early in the project

1. DCS system shall be upgraded to the most advanced technology available on the market today, maximizing the life cycle for the hardware, system software and services.
2. The latest advance control and maintenance management technology shall be deployed to maximize return on the investment.
3. The existing DCS functionality shall be maintained.
DCS Qualification Requirements are used to qualify and select DCS vendors

- **Principle Requirements**
  - This specifies the “tool box”, ie: temperature ratings, analog resolution, vibration requirements communication protocol, auto tune, advance control etc

- **DCS Qualification Requirements**
  - At Solvay, the DCS selection process had already been completed for North America at the corporate level.

- **Configuration & Service Specification (CSS)**

- **Generate a Quote**

- **Vendor Selection**

- **Functional Specification**

- **Design Specification**

- **Scope Changes**
The CSS addresses the challenge of obtaining an accurate quote without generating a functional spec.

**Principle Requirements**

**DCS Qualification Requirements**

**Configuration & Service Specification (CSS)**

This specifies the “house”: the square footage, number of rooms, ranch or colonial, lot size, neighborhood.

The objective is to:
- Generate quotes that are comparable
- Minimize Scope Changes

A feed study is used as the starting point for this document.

**Generate a Quote**

**Vendor Selection**

**Functional Specification**

**Design Specification**

**Scope Changes**
The Configuration & Service Specification defines the high level requirements

- Work Stations
- History
- Controller
- IO Requirements
- Gateways
- Graphics
- Control & Sequences
- Batch
- Reporting
- Project Execution
- Documentation Deliverables
- Factory Acceptance Test
- Startup
- Support Services
- Training
- Service Labor Rates
- Customer Deliverables

The CSS is not a functional specifications document and does not specify system performance parameters or provide functional definition for the application software development.
Document organization and structure are important aspects in generating a successful specification.
Document organization and structure are important aspects in generating a successful specification (continued)

5.2. Training
5.2.1. Operator Training
5.2.2. Technician Training
5.2.3. Engineering Training
5.2.4. Process Engineering Training

5.3. Service Labor Rates

5.4. Application Engineering Scope Change Standard Costs

6. Customer Deliverables Summary

7. Optional
7.1. Spare Parts
7.2. MOD300 – residual
7.3. Control Room Console Furniture
7.4. Advance Control
7.4.1. Asset Management
7.4.2. Advance Process Control
7.5. Wireless Technology
7.6. Operator Training and Engineering Development Station
7.7. Instrumentation Field Study

Attachment I: System Overview of the Existing Rhodia DCS System
Attachment II: Workstation Layout
Appendix III: Existing Marshalling Cabinets
Appendix IV: Final Configuration of Marshalling Cabinets
The information provided in a CSS should be summary information, not functional details.

2.6. IO Hardware
The following table summarizes the IO (including gateways) for the entire system:

<table>
<thead>
<tr>
<th>#</th>
<th>Direct IO</th>
<th>Triconex</th>
<th>Medicon</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1549</td>
<td>0</td>
<td>1149</td>
<td>562</td>
</tr>
<tr>
<td>2</td>
<td>384</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1150</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

2.6.1. IO Summary Tables

<table>
<thead>
<tr>
<th>Category</th>
<th>Cathy</th>
<th>Daphne</th>
<th>Vanessa</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Process Sequences</td>
<td>88</td>
<td>95</td>
<td>93</td>
<td>274</td>
</tr>
<tr>
<td>Total Memory of files</td>
<td>486</td>
<td>519</td>
<td>456</td>
<td>1460 kb</td>
</tr>
<tr>
<td># of non Critical Intk (NCI) Sequences</td>
<td>42</td>
<td>30</td>
<td>31</td>
<td>103</td>
</tr>
<tr>
<td>Total Memory of files</td>
<td>1150</td>
<td>1011</td>
<td>801</td>
<td>2962 kb</td>
</tr>
<tr>
<td># of Sequences for NCI HMI</td>
<td>30</td>
<td>29</td>
<td>42</td>
<td>101</td>
</tr>
<tr>
<td>Total Memory of files</td>
<td>126</td>
<td>127</td>
<td>207</td>
<td>462   kb</td>
</tr>
<tr>
<td># of Include Files</td>
<td>0</td>
<td>95</td>
<td>0</td>
<td>95</td>
</tr>
<tr>
<td>Total Memory of files</td>
<td>0</td>
<td>600</td>
<td>0</td>
<td>600   kb</td>
</tr>
</tbody>
</table>

3.5. Sequences
Table 3.2 below summarizes the TCL and includes files. The total memory used for each type of file is also provided to help assess the complexity of each area. The sequences are divided into four types:

<table>
<thead>
<tr>
<th>Category</th>
<th>Cathy</th>
<th>Daphne</th>
<th>Vanessa</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # Sequences</td>
<td>478</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Memory of TCL files</td>
<td>4884</td>
<td></td>
<td></td>
<td>600   kb</td>
</tr>
<tr>
<td>Total # of Include files</td>
<td>95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Memory of Include files</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary Information is sufficient for DCS vendors to generate quotes
The Vendor quoting process uses summary data, averages & statistics to generate a proposal.

- Principle Requirements
- DCS Qualification Requirements
- Configuration & Service Specification (CSS)
- Generate a Quote
- Vendor Selection
- Functional Specification
- Design Specification
- Scope Changes

The CSS compliments this process.

The following should be defined:
- Quantity
- Complexity (simple, medium, Complex)
- Identify areas that are Unit Relative

The CSS is designed for statistic based quoting.

Consider using a Kepner Tregoe decision matrix (or similar tool).
A migration project leverages the existing software as the primary functional specification.

- **Principle Requirements**
- **DCS Qualification Requirements**
- **Configuration & Service Specification (CSS)**
- **Generate a Quote**
- **Vendor Selection**
- **Functional Specification**
  - This specifies the interior & exterior: landscape, furniture, carpet, building materials, etc.
- **Design Specification**
  - The existing application software provides the starting point of this specification.
- **Scope Changes**
DCS Functional specification is critical in replicating the functionality, define your expectations in its specification

**Solvay – CathyVal**
MOD300 Application Functional Specification

Rev A2; 6/9/13

1. **Project Overview** .......................................................... 2
1.1. **Scope Summary** .................................................. 2
1.2. **Functional Description and Design Specification Overview** ....... 4
1.3. **Schedule & Process Overview** ........................................... 6
1.4. **Sample Functional Specification** ........................................ 6
1.5. **Document History** .................................................. 6
2. **Control Function Descriptions** ........................................... 7
3. **Sequences (TCL)** .................................................. 7
4. **Instance tables** .................................................. 7
Define what you expect for sequence documentation

**Flow Chart**

1. Default Trip; take action
   - If Tripped AND Not Bypassed AND not overridden
     - Then Execute Interlock
       - Inhibit Operator (PUT Loop On)
       - Execute Actions
       - Set Action Bit (???)

2. Enable Reset
   - If No Default Conditions OR No Bypass AND Ack Cond AND In Action Then Clear
     - Send Message to Operator
     - Make Reset Button Blink
     - Reset #!!! = Enable
     - Initialize Reset to Normal
     - C_RESET_!!! = Normal

3. Reset System To Normal Operation
   - If Reset Is Enable and Requested Then Reset
     - - Reset Devices
     - - Set ACT_!!! = Normal
     - - Enable Operator Access
     - - Enable Equipment

4. Manage Acknowledge
   - If Alarm And Ack Are Good Then
     - Set #!!! = Normal
     - Set ACT_!!! = Normal

**Psuedo Code**

1. Action is executed if the following conditions are met:
   a. Default Condition in NCI table exists
   b. The default is not bypassed
   c. The action is not overridden
   d. Execute actions defined in the NCI table
   e. Inhibit operator controls

2. Each default will have an operator acknowledge button

3. Reset Requirements
   a. Enable the blinking Reset button and send message to operator if the following conditions are met
      i. The default condition has been cleared
      ii. The default is not bypassed
      iii. The alarm is acknowledged
      iv. Action is engaged
   b. Resetting an action
      i. Reset the action
      ii. Enable operator control
      iii. Reset the acknowledge
Document the functionality, then Replicate the requirements and innovate the solution.

5.1.1. Blender Low Flow Interlock Requirements

The following are the requirements for the low flow blender interlock:

1. A flow loop (F0166101) shall be created by taking the derivative of the blender weight load cell (W0166101)
2. A Low level alarm shall be generated for a flow below 10
3. A Low-Low Level alarm shall be generated for a flow below 5
4. The interlock shall be enabled 3 minutes after X0166301 is diverted to blender T661
5. The interlock shall be integrated into the Non-Critical Interlock infrastructure CFD-1
6. When F0166101 < 5, then the interlock shall take the following actions:
   a. Divert X0166301 to T661
   b. Stop SM016610F
7. The operator shall not be able to access the interlock threshold settings nor disable the interlock
8. The process graphic shall have the following functions added:
   a. F0166101 value shall be displayed on the process graphic
   b. The status of this Non-Critical Interlock shall be displayed next to the valve X0166301

Loops will change

New

Number of rows will be the same
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