Common Pitfalls that Affect Water and Wastewater Instrumentation, Control and Automation Systems

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2012 ISA Water & Wastewater and Automatic Controls Symposium
August 7-9, 2012 – Orlando, Florida, USA
Presenter

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What are we going to cover?

• Problem Definition.
• Historical Background and Driving forces behind ICA Projects
• Instrumentation, Control and Automation Project Life Cycle
• Research Methodology And Survey Design
• Survey Results
• Common Pitfalls That Affect Water And Wastewater Instrumentation, Control And Automation Systems
Problem Definition

General belief that Instrumentation, control and automation project delivers:

- User Friendly
- Flexible
- Powerful

However, the measurement of the cost/benefits is generally difficult to determine (Olsson, 2005).

The open questions that remains: The benefits will translate into improved performance and reduction of operational cost?

Why newly installed system does not perform as expected?

Why reinvestment will be needed to update a newly control system.
Problem Definition
What does the literature indicates.

The Guide to the Automation Body of Knowledge
- Replacement of automation approach
- Project team approach
- Lack of real-time accounting

7 Steps of Automation Project Success
- Realistic schedule
- Qualified supplier
- Proper specification
- Progress checks and formal factory acceptance test
- Timely synchronization of multidisciplinary team
- Effective training
- Keep problem and issues on track

Crews Checkpoint Technologies
- Unrealistic expectations
- Same methodology used for automated as manual
- Overly complex framework
- Fail to utilize basic features of automated testing
Historical Background and Driving forces behind ICA Projects

Expansions
- Response to:
  - Demand and economical cycles.
- Oriented to serve needs for:
  - Process
  - Operation
- Major challenges:
  - Technology selection
  - Flexibility to changes
  - Maintenance and operational cost

Regulations
- Response to:
  - Regulation requirements
  - Consent decrees
- Oriented to:
  - Specialized processes
  - Analytical instrumentation
  - Reporting
  - Avoid be out of compliance.
- Major challenges:
  - Accountability
  - Operational changes
  - Data management
  - Knowledge management

Technology Changes
- Response to:
  - Operational continuity
- Oriented to:
  - Technology replacement
- Major challenges:
  - Technology selection
  - Bumpless implementation

Improvements/Optimizations
- Response to:
  - Expense reduction
  - Energy efficiency
  - Resource optimization
- Oriented to serve needs for:
  - Process
  - Operation
- Major Challenges:
  - Project justification
  - Accountability
  - Bumpless implementation
  - Knowledge management
  - Benefits accountability
Instrumentation, Control and Automation Project Life Cycle

- Long Range Planning
- Feasibility Study
- Project Definition
- Organization of the Project Team
- Bid Packages / Negotiation and Order
- Project Management
- Commissioning/Startup
- Operations and Support
- Continuous Improvements
The Delphi method is based on structural surveys and makes use of information from the experience and knowledge of the participants, who are mainly experts. It therefore yields both qualitative and quantitative results.

The method requires knowledgeable and expert contributors that individually respond to a survey. For this purpose a group of experts in the area of instrumentation and control for the water and wastewater industry was organized.

The process to be followed for the execution of the Delphi method has the following Four steps:
1. Survey development
2. Initial questionnaire and feedback – qualitative comments solicited
3. Subsequent questionnaire and feedback – qualitative comments solicited again
4. Consensus, analysis and results
Research Methodology And Survey Design

• The survey was designed to obtain consequent information from the experts for the general phase of an Instrumentation Control and automation life cycle to the particular possible bad practices that may affect the success of the ICA Project/System.

• The survey was presented to a panel of automation experts with more than 10 years of experience in the water and wastewater industry.

• For comparison purposes the survey was also published at http://www.surveymonkey.com/s/D77592Q and offered in several email and social media groups related to the automation business.
Research Methodology And Survey Design

Objective A: Identify major critical phases and factors that may affect project development and system life cycle

1. Project definition
2. Project specification and design
3. Project bid package and contract
4. Project management execution, construction, and implementation
5. Change in technology
6. Maintenance and knowledge management
7. Others
Objective B: Within each critical factor identified, rank the issues that may affect project development and system life cycle.
Survey Results
Participants

Role in ICA projects
- Designer, 32.0%
- System Integrator, 28.0%
- Project Manager, 24.0%
- Instrumentation System Supplier (Contractor), 8.0%
- Owner/Client, 8.0%

Experience
- More than ten years
- Five to ten years
- Less than five years
Survey Results
Major critical phases and factors that may affect project development and system life cycle

- Maintenance and Knowledge Management: 54.76%
- Change in Technology: 35.71%
- Project Management Execution, Construction, and Implementation: 85.71%
- Project Bid Package and Contract: 73.81%
- Project Specification and Design: 90.48%
- Project Definition: 76.19%
### Survey Results

**Project Definition major issues**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrealistic schedule</td>
<td>91.43%</td>
</tr>
<tr>
<td>Project ownership not considered in project definition</td>
<td>60.00%</td>
</tr>
<tr>
<td>Errors and omission in project scope</td>
<td>68.57%</td>
</tr>
<tr>
<td>Incomplete project justification</td>
<td>45.71%</td>
</tr>
<tr>
<td>Lack of long range planning</td>
<td>34.29%</td>
</tr>
</tbody>
</table>

### System Life Cycle

<table>
<thead>
<tr>
<th>Issue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrealistic schedule</td>
<td>37.14%</td>
</tr>
<tr>
<td>Project ownership not considered in project definition</td>
<td>45.71%</td>
</tr>
<tr>
<td>Errors and omission in project scope</td>
<td>40.00%</td>
</tr>
<tr>
<td>Incomplete project justification</td>
<td>54.29%</td>
</tr>
<tr>
<td>Lack of long range planning</td>
<td>82.86%</td>
</tr>
</tbody>
</table>
## Survey Results

### Project Design and specification major issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few/lack of consideration of maintenance factors</td>
<td>55.56%</td>
</tr>
<tr>
<td>Error/omission of important elements in control architecture</td>
<td>77.78%</td>
</tr>
<tr>
<td>Error/omission of important aspects in design</td>
<td>88.89%</td>
</tr>
<tr>
<td>Selection of field adequate instrumentation</td>
<td>66.67%</td>
</tr>
<tr>
<td>Selection of adequate SCADA/HMI</td>
<td>59.26%</td>
</tr>
<tr>
<td>Selection of adequate PLC/DSC</td>
<td>62.96%</td>
</tr>
</tbody>
</table>

### System Lifecycle

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<tr>
<td>Few/lack of consideration of maintenance factors</td>
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</tr>
<tr>
<td>Error/omission of important elements in control architecture</td>
<td>62.96%</td>
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<td>Selection of field adequate instrumentation</td>
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</tr>
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<td>Selection of adequate PLC/DSC</td>
<td>70.37%</td>
</tr>
</tbody>
</table>
Survey Results
Bid Phase, Project Management and Changes in Technology

Bid Phase in terms of Project Execution
- Long gap btw design and bid is source of major issues: 69.23%
- Times and Budget is the source of major issues: 80.77%
- Qualifications Based selection delivers the least benefit: 46.15%
- Cost Based selection delivers the least benefit: 46.15%

System Life Cycle
- Field instrumentation: 28.00%
- PLC/Controllers: 48.00%
- HMI/SCADA: 44.00%

Project Management
- Schedule management: 88.00%
- Lack of PM knowledge in technology: 48.00%
- Lack of PM knowledge in process: 60.00%
- Communication strategy: 72.00%
Survey Results

Maintenance Cost, Training/Documentation and High rotation or lack of skilled personnel

- **Maintenance Cost**
  - Field Instrumentation: 59.26%
  - PLC/DSC: 7.41%
  - HMI/SCADA: 18.52%

- **Training/Documentation**
  - Field Instrumentation: 11.54%
  - PLC/DSC: 25.93%
  - HMI/SCADA: 40.74%

- **High rotation or lack of skilled personnel in charge of Support and Maintenance**
  - Field Instrumentation: 51.85%
  - PLC/DSC: 42.31%
  - HMI/SCADA: 62.96%
1. Insufficient resources invested during the project definition

   - When insufficient resources and time are invested in the project definition there is a high risk to overlook important factors that allow the development of a thoroughly defined specification.

   - A well thought project definition, documented with clear statements able to communicate the project benefits, goals and objectives, is the initial point for a successful project.
2. Lack participation of key stake holder or the ownership dilemma

   - A project team that takes into consideration the importance of input from key stakeholders such as the end users and maintenance personnel will help to build the ownership that is necessary to ensure project success.

   - The degree of complexity of the automation required the best contribution of each member team, specially the one that will be in charge to run and maintain the system.
3. Lack of long range view

- Long range vision is an important factor that needs to be taken in account during the selection of major equipment and consideration for annual maintenance costs. Long range view is also an important key to developing the system roadmap for medium to large scale automation systems.
4. Unrealistic schedule and the snowball effect

- When unrealistic schedules are imposed project quality is affected because team members may overlook important factors and sidestep processes to meet deadlines.

- “An oversight early on in the process that is discovered later on will have an amplified impact on the project. This compounding behavior is easy to underestimate because the cause and effects aren’t often visible at the same time. In the worst case, when several major oversights occur, the odds of the schedule hanging together are slim to none” (Scott Berkun o “Making Things happen)
5. Overlooking of interdisciplinary project collaboration during the design and specification phase
   – It is critical to spend quality time with plant supervisors, end users, maintenance personnel and perform a site visit whenever possible

   – Concurrent design with continuous interaction with members of other disciplines such as process mechanical and electrical is also a recommended practice in order to reduce design inconsistencies.
6. Underestimate the communication strategy
   – Project leaders shall focus their communication strategy on quality and effectiveness.

   – The communication strategy needs to be developed to build a good relationship and synergy among the team members.

   – The excellent communication strategy minimizes the message distortion that is commonly responsible for wrong expectations.
7. Do not develop a knowledge management plan
   – knowledge and the capacity to build knowledge is typically one of the assets
devalued along the automation system life cycle.

   – Constant personnel rotation and the pressure of continuous technological
changes are driving force that affects knowledge management around an
automation system.

   – Knowledge management is not only about managing knowledge assets but
managing the processes that act upon these assets. These processes include:
developing, preserving, using and sharing of knowledge