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Telemetry/SCADA - Project Delivery Options & Pitfalls

By:

Terry M. Stulc, P.E.

Trindera ENGINEERING

COEUR D'ALENE, IDAHO

www.trindera.com

Introduction – Topics Covered

- Brief discussion of the typical options for bidding, procuring, installing and implementing telemetry and SCADA projects for water systems.
  - Conventional design-bid approach
  - Alternative design-build approach
  - Turnkey solutions (often referred to as engineered solutions)
- Summary pros/cons of the various project delivery mechanisms.
- Lessons learned
- Questions & Answers Period

Starting Point For Discussions

- Audience Poll:
  - How many are familiar with Telemetry and SCADA systems?
    - RTU or PLC based system?
    - Radio based?
    - SCADA software packages?
  - What type of installation contract did you use?
    - Design-Bid?
    - Design-Build?
    - Turnkey?

Typical Telemetry/SCADA System Components

- Design
  - Drawings, specification, cost estimates
- Project Management / Construction management
  - Schedule, coordination, startup, training,
  - O&M manuals / documentation, O&M
- Hardware
  - Programmable Logic Controls (PLCs)
  - Remote Telemetry Units (RTUs)
- Communication Media
  - Leased line telephone lines or dedicated line
  - Radios – FCC licensed or unlicensed
  - Other
- SCADA Software
  - Computer based Graphical User Interface (GUI)

Project Elements Provided by Who?

- **Design-bid**
  - Design = Engineer (or vendor) prepared bid documents
    - Drawings and specifications
  - PM/CM = Owner or Engineer
  - Hardware = By contractor (thru integrator)
    - Installation by contractor
    - Panels and components by integrator
  - Communication Media = May be by Owner, or by contractor
    - Need integrator involvement to implement.
  - SCADA Software = May be by Owner, or by contractor
    - Need integrator involvement to implement.

Project Elements Provided by Who?

- **Design-build**
  - Design = Engineer and contractor (vendor or integrator
    - Provided drawings and specifications may be limited
  - PM/CM = Owner or Engineer or Contractor
  - Hardware = By contractor (thru integrator)
    - Installation by contractor
    - Panels and components by integrator
  - Communication Media = May be by Owner, or by contractor
    - Need integrator involvement to implement
  - SCADA Software = May be by Owner, or by contractor
    - Need integrator involvement to implement

Project Elements Provided by Who?

- **Turnkey Solution**
  - Essentially everything provided by Contractor
  - Still may require Engineer/Contractor/Vendor/Integrator team
  - Owner may still provide some system components

Evaluation Criteria (Typical/Historical)

- **Design-Bid**
  - Conventional method for larger projects
  - Typical for publically funded projects
    - Advertised, available at plan centers, completive bid, competitive cost
      - Requires Engineer/Contractor/Vendor/Integrator team
      - Owner may still provide some system components
- **Design-Build**
  - Often used for smaller systems/projects
  - District boards often favor this approach, especially if they know preferred contractor/vendor
  - Can be used for private or publically funded projects
  - Limited publicity (advertisements) and competition
  - Still may require Engineer/Contractor/Vendor/Integrator team
  - Owner may still provide some system components

Typical Pros

- **Design-Bid**
  - Allows for more competition, theatrically providing better price competition
  - Typically has longer design phase schedule, theatrically allowing for more communication and coordination with Owner regarding system requirements
- **Design-Build**
  - Pricing can be competitive based on reputation security
    - Good price and good quality due to desire to maintain reputation and relationships
  - Schedule can be shortened because construction (implementation) issues are being coordinate better during design phase

Typical Cons

- **Design-Bid**
  - Requires additional effort to prepare, package, advertise, bid and award.
  - Contractors/integrators/vendors often do not get valuable input into hardware, software, communication options, etc.
- **Design-Build**
  - Contractors/integrators/vendors often push their own preference onto the owner, sometimes without due diligence in exploring options, costs, and long term impacts.
  - End of project tasks such as record drawings, O&M manuals and training are often eliminate from project scope.

Single Point of Contact – Pros and Cons

- **Pros or Cons – you decide**
  - Owner has one contact point for all project issues
  - Owner may also have less overall involvement in project details
    - Issues may not be fully explored and resolve
  - Owner/Engineer/Contractors/Integrators/Vendors make up project team – all have valid and valuable input into project
    - All must be involved for successful project

Engineer/Owner Provided Programming – Pros and Cons

- **Pros or Cons – you decide**
  - Owner may have staff capable of doing work, but not time available.
  - Engineer has vested interest in project thru reputation.
    - Contractor and integrators do too, but if low-bid project they may be force to “compete” at level not of their choosing
  - Requires more involvement from entire team
    - Contractor, panelshop, vendor
    - May lead to more meetings, more time onsite, etc.
  - Owner/Engineer’s budget may not be tied to capital budget for project – need to evaluate overall cost and flexibility for software changes/modifications, training, and documentation

Selection of Project Delivery Method

- Which methods suites you needs? What's the driver?
  - Cost
  - Select contractor
  - Select vendor
- You get what you pay for!
  - Need detailed project scope
  - Need tight project specifications
  - Need qualified contractor
  - Need tight project management
  - Need rigorous testing and commissioning
  - Need to consider future costs and needs
    - Hardware/Software maintenance and replacement
    - Operations, maintenance, troubleshooting

Selection of Project Delivery Method

- Cost as the driver?
  - Again, you get what you pay for!
  - Design costs (specifically better specifications) can be “recouped” thru avoided construction issues, or after project costs
  - Design costs are part of overall project cost (and therefore should be budgeted)
    - Design required whether provided by engineer, vendor or integrator
  - Design should include future plans for system, so future costs for upgrades, expansion, replacement can be minimized or avoided

Selection of Project Delivery Method

- Select contractor/vendor as the driver?
  - Experience, staff, price, locale, equipment represented?
  - Through use of tight project specifications, should be able to ensure participation of only qualified contractors
  - Cost needs to be evaluated on “apple-to-apples” basis (only)
    - Difficult to do sometimes without base performance requirement or common project specifications
  - Location is an important issue
    - Local support requirements can be written in specifications/contract
  - Equipment used
    - Again, need baseline performance requirements (project expectations for current AND future needs)

Defining Project Scope and Requirements

- Owner needs to lead definition of expectations
  - Lead, not necessarily do
  - Owner may need outside consultations to define
  - Owner sets budget
  - Owner may need outside consultations to determine bid/contract options

Defining Project Scope and Requirements

- Project specifications
  - Need to address many items other than just hardware and software components
  - Functional requirements for hardware – relatively easy to do
  - Functional requirements for software package(s) - fairly easy
  - Functional requirements for software implementation – hard
    - Owner needs to define report needs, alarming requirements
    - Graphical standards for screens
      - Colors to be used for standard operations (Ex: On = Green (or red)
  - Testing requirements
    - In shop
    - In field

Defining Project Scope and Requirements

- Project specifications
  - As important and component specs, the project specifications need to address quality control and workmanship
  - Panel fabrication
  - Installation
    - Panel installation
    - Conduit / wire
    - Antennas and communication system components
    - Power quality and surge protection components
    - Grounding

Defining Project Scope and Requirements

- Project specifications
  - Testing versus commissioning
    - Must test everything, all components, all I/O
    - Must test for failure modes, not just proper baseline operation
  - Startup is chaotic, and not the overall best time to do validation testing
  - Commissioning is really the validation phase, and it involves real operational issues, including staff related issues

Defining Project Scope and Requirements

- Project specifications
  - Training
    - Needs to be formal
      - Schedule, agenda, attendance
      - Need O&M Manuals available at time of training
        - Need to review in detail during training
    - Needs to be split up
    - Initial training (during startup), class room training, follow-up training
    - Project startup, 6months, 11-12months (prior to end of warranty)

Case Study
Rockford Washington Water System Telemetry

- Issues:
  - Inexperience Contractor
    - Additional onsite PM/CM required
  - Panel fabrication quality
    - Panel shop acceptance testing missed
      - Didn't get coordinate by contractor
      - Panels arrived onsite without prior notice
    - Functional testing had to occur in field
    - "Patches" had to be made in field
  - Remote wireless I/O integration into Radio based master telemetry
    - Vendor responsible for wireless I/O
    - Integrator responsible for radio system
    - Contractor responsible for installation of both
    - Engineer responsible for software integration
      - Testing, troubleshooting
        - Lack of coordination followed by finger pointing.

Case Study
Rockford Washington Water System Telemetry

- Lessons Learned
  - Owner must allow enough budget for PM/CM for proper implementation
  - Contractor/integrator/vendor and Engineer/Owner must function as a tightly integrated team.
  - Operators must weigh in on required operator interface and functionality requirements early in project not during (or after) startup.
  - Must allow adequate time (and operational flexibility) for startup/testing,
- Positives
  - Small town now has advanced, flexible, system with room for growth
- Opportunities for improvement
  - Software functional description needs to be more detailed during design phase.

Pitfalls to Avoid

- Focus on initial project cost (only)
  - Plan for change orders
    - Build into budgets and control thru specifications/contract
  - If using Design-build or turnkey options, plan for after-the-fact “additions” (i.e. change orders)
    - Additional I/O brought into system
      - Future flowmeters, pressure sensors, etc.
    - Additional reporting at SCADA
    - Modifications to alarming needs after operations uses system

Pitfalls to Avoid

- Focus on initial project cost (only)
  - Plan for replacement costs
  - Life cycle of hardware components may only be 10yrs
    - Plan for component replacement
  - Life cycle of software components may only less than 5yrs
    - Plan for upgrades in SCADA software and PC hardware

Pitfalls to Avoid

- Relying solely on contractor for project management or construction management
  - Plan to monitor and manage contractor's schedule in detail
  - Plan to inject in contractor's schedule for testing, startup and commissioning (to suite your needs as owner)
  - Plan to inject in contractor's training efforts to require additional detailed training if needed
- Punchlists and Warranty
  - Plan on 3 or more rounds of addressing punchlist items
    - Each resolution of some punchlist items may require additional testing/commissioning
      - Rewiring
      - Component replacement

Installation Details - Enclosure Ratings

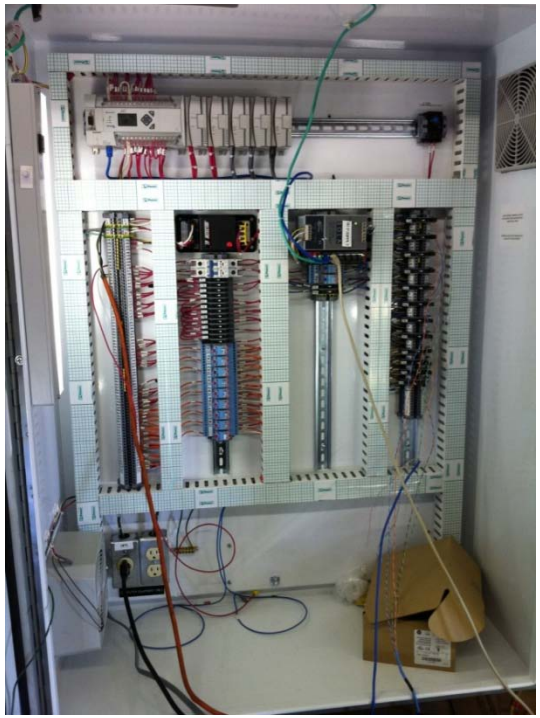
- Most Common NEMA Ratings: 1, 3R, 4, 4X, 12, 13,
  - NEMA 1 = not gasketed
  - NEMA 4/12 gasketed (curved lip around opening)
  - NEMA 4X – Same as 4, including protection against corrosion (FRP or SS typ.)
  - NEMA 3R = Rain Shield

NEMA 4 Enclosure:

- Gasketed door
- Curved lip around opening
- Added cooling components

Installation Details

- Programming terminal connection
  - Operator safety
  - External connections versus internal (to panel)



Installation Details

- Conduit penetrations and sealing

Installation Details

- Quality Control

Installation Details

- Quality Control

Grounding Issues

- Where to ground
- How to route ground conductor

Grounding Issues

- Ground rods – type, size and installation

Summary

- Discussion of design-bid versus design-build
- Discussion of design-bid/build versus Turnkey Solutions
- Discussion of design issues and implementation issues (aka lessons learned)
- Discussion of pros and cons of various approaches

Summary

- **<u>Questions and Answers</u>**