Modularization in Automation

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- Why Modularize?
- Challenges
- Old Way
- Automation and Modularization
- Options
- Scalability
What goes into Building a plant?

- Conceptualization
- Pre Engineering, Budgetary, Detailed Design
- Bid Process to Multiple Interfaces, EPC, GC, EC
- Old Way: Stick Build from Ground Up
- Requires skilled craft labor on-site
Challenges to Traditional Plant Builds

- Access to Remote Sites, logistics, T&E, infrastructure
- Severe Weather
- Schedules
- Regional Skilled Labor Availability (severe shortage)
- Planning and equipment delivery
- FAT, SAT coordination
- Multi-party interfacing
- Limited Mega Project Know How
Modularization

- Construction of Pre-fabricated plant modules assembled on site (Lego build)
- Support Structure, instrument stands, piping, wiring, fireproofing, insulation installed on modules and assembled on site
Considerations in Modularization

- Planning – How to make late in game changes?
- Up front engineering costs increase but schedule improves
- Shipping of Modules – logistics may be better
- Potential Build, Disassemble, Rebuild
- Where is the break even in cookie cutter to modular? Several tiers, OTS, Semi custom, custom
- How to handle flexibility
- Black Box Mentality – “Islands of Automation”
Advantages to Modularization

- Earlier Planning considers scalability and ROI
- Engineering done prior so costs are controlled
- Faster Schedule to Production
- CapEx, OpEx, and TCO are defined
- Expandable
- Scalable
Automation in Modular World

- How Handle?
Project Task Analysis - BEFORE

- I/O lists & controller sizing
- Power, grounding & fusing design
- I/O design
- Spares sizing
- Cabinet design

- Conduit & cable layout
- P&IDs
- Process narratives
- Installation package

- Cabinet design
- Jumpers & terminations
- Wiring diagrams
- Cable layout

- JB design
- Jumpers & terminations
- Wiring diagrams
- Cable layout
Traditional Practice

1914, Switchboard Operator

Cabinet Technician

Field Technician
How Do We Do It Now?

- Just like in a stick build we wire each point from the Controller (DCS or PLC) to the instruments.
- For 60 instruments you have between
  - 720 and 4000 terminations
  - Upwards of 200 cables
  - Documentation for each point
  - Ring outs for FAT at modular site
  - Ring outs again at SAT
How Is this Better?

- Not necessarily better from automation standpoint unless how we automate is changed to reflect a modular construction
- Options
  - PLC
  - DCS with Remote IO
PLC

- PLCs can control small skids and stand alone, Black Box
- Advantages
  - Relatively Inexpensive
  - Can often be located on skid and eliminate $\frac{1}{2}$ of the wiring, but normally do not transport on module
- Disadvantages
  - Not easily scalable
  - Integration into DCS can be difficult
  - Vibration shipping
  - Added Controller Cost
  - Independent Operations Staff
  - Area Classification considerations
  - Asset Management and HART difficult
DCS with traditional Wiring

- Difficult to do at a reasonable cost
- Buses could mitigate
- Huge Electrical Cost
Traditional Wiring

**Receiving & Gridding**
- Instruments: 12
- Cables: 48
- Terminations: 192
- Man Hours: 240
- Wiring Labor: $16,800

**Leaching, Decantation, Clarification & Packaging**
- Instruments: 318
- Cables: 1,272
- Terminations: 5,088
- Man Hours: 6,360
- Wiring Labor: $445,200

**Solvent Extraction**
- Instruments: 96
- Cables: 384
- Terminations: 1,536
- Man Hours: 1,920
- Wiring Labor: $134,400

**Water Treatment**
- Instruments: 57
- Cables: 228
- Terminations: 912
- Man Hours: 1,140
- Wiring Labor: $79,800

**Crystallization**
- Instruments: 38
- Cables: 152
- Terminations: 608
- Man Hours: 760
- Wiring Labor: $53,200

**Control Room**
Traditional I/O

Remote I/O with Electronic Marshalling
DCS with Remote IO

- Remote IO can stand alone on skid and replace marshalling box and junction boxes
  - Advantages
    - Standard off the shelf enclosures shipped, wired, and IO selected on-site
    - Plug and play IO
    - Easy to make late in game changes
    - Reduction in schedule and engineering costs
    - Four fold reduction in wiring
    - Scalable
  - Disadvantages
    - Hardware can be higher priced than PLC hardware
    - Normally does not communicate with other DCS
Remote I/O Optimization

**Receiving & Grinding**
- Instruments: 12
- Cables: 48 13
- Terminations: 192 48
- Man Hours: 384 55
- Wiring Labor: $26,880 $3,850

**Leaching, Decantation, Clarification & Packaging**
- Instruments: 318
- Cables: 1,272 325
- Terminations: 5,088 1,272
- Man Hours: 10,176 1,380
- Wiring Labor: $712,320 $96,560

**Solvent Extraction**
- Instruments: 96
- Cables: 384 97
- Terminations: 1,536 384
- Man Hours: 3,072 484
- Wiring Labor: $215,040 $33,880

**Crystallization**
- Instruments: 38
- Cables: 152 39
- Terminations: 608 152
- Man Hours: 1,216 286
- Wiring Labor: $85,120 $19,990

**Water Treatment**
- Instruments: 57
- Cables: 228 58
- Terminations: 912 228
- Man Hours: 3,648 246
- Wiring Labor: $255,360 $17,240

**Total Estimated For Savings for this Case:**
$557,880
Real Benefits

- Amgen, Juncos
- Ineos Phenol Biodeisel, Vero Beach, FL
- Large Pharma in Georgia
- Large Pharma in Clayton, NC
- Upstream Gas Producer, Colorado
Summary

- Modularization offers advantages in schedule, total cost of ownership, and scalability
- Differences in “cookie cutter” designs and modular prefabricate units will vary in cost advantages
- Automation must be a different consideration than typical modularization depending on types of modules
- Automation advantages can only be realized if skids are designed with modular IO