Instrumentation with Field Bus Technology:

Building Foundation to Meet Future Challenges
Field Bus: A Way Forward

Conventional System ➔ Fieldbus Control System

- Plant Operation & Control
- Device Management Diagnostics Server

Automatic Alarm Notification from Device

**BENEFIT FORM FIELD BUS**
- New Technology to achieve high quality, low cost and expendibililty
- Optimize operation by improving control model precision
- Improve process safety / stability by more process information
- Predictive maintenance based on device diagnose data
- Acquire field information to improve process capability
Why Field bus?

What gain?
Field Bus: A Way Forward

The Business Perspective – How can we survive in the competitive world?

- Fast Commissioning & Startup
- Reliable Project Documentation
- Reduce cost of poor quality
- Reduce Maintenance costs
- Improve predictability
- Increase Return on Capital investment
- Low Capital Investment
ROI – Improvement

Engineering

Increase ROI

Reduce Capital Cost

Reduce conversion Costs

- Reduced Project Capital, Installation & Commissioning Cost
- Reduced Feed stocks, Energy and Utilities, Maintenance, waste, Abnormal Events

Increase Profitability

- Increased Yield, Consistency, Equipment Capacity, Equip. Efficiency

Increase Revenue

- Reduction of losses
- Reduced Unscheduled Downtime & Small stoppages, Low Maintenance time, Reliable History

Product Development

Increase Profitability

Increase Revenue

Increase Productivity

Reduction of losses

Resources, Reliable History
Field Bus: A Way Forward

Refineries on FF:

- 2.3 million barrel /day Nanhi
  30,000 FF devices and commissioned in 2005. Field bus foundation used for entire plant automation

- TENCO Refinery Russia
  45,000 FF devices and commissioned in 2006. Field bus foundation used for entire plant automation

- ConocoPhilips YERP Refinery Saudi Arabia
  25,000 FF devices and commissioned in 2006. Field bus foundation used for entire plant automation
Refineries on FF:

- Petro Rebigh, Saudi Arabia
  
  30,000 FF devices and commissioned in 2006. Field bus foundation used for entire plant automation
### Chevron Refineries under going FF:

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>325,000 barrel /day</td>
<td>Mississippi</td>
</tr>
<tr>
<td>300,000 barrel /day</td>
<td>Mississippi</td>
</tr>
<tr>
<td>260,000 barrel /day</td>
<td>California</td>
</tr>
<tr>
<td>225,000 barrel /day</td>
<td>California</td>
</tr>
<tr>
<td>45,000 barrel /day</td>
<td>Salt lake</td>
</tr>
<tr>
<td>52,000 barrel /day</td>
<td>Canada</td>
</tr>
<tr>
<td>210,000 barrel /day</td>
<td>UK</td>
</tr>
<tr>
<td>54,000 barrel /day</td>
<td>Hawaii</td>
</tr>
<tr>
<td>112,000 barrel /day</td>
<td>South Africa</td>
</tr>
</tbody>
</table>
Emerson to Digitally Automate China's Largest Integrated Refining/Petrochemical Facility:
EPM has been selected to digitally automate the Fujian Refining and Ethylene Joint Venture Project in Quanzhou City, Fujian Province, China. It is the largest integrated refining and petrochemicals project ever undertaken in China. Project startup is expected by 2009.
EPM will serve as the Main Instrument and Controls Contractor (MICC) on the project, and will install its PlantWeb. The PlantWeb installation will include eight DeltaV, AMS, safety instrumented system (SIS), fire and gas systems, Rosemount pressure and temperature transmitters, plus Fisher digital valve controllers, all utilizing FOUNDATION fieldbus, HART, OPC and Modbus communication technologies, and delivering information to a real-time database.
Emerson to Digitally Automate China's Largest Integrated Refining/Petrochemical Facility:
The project will expand the existing refinery at Quanzhou, Fujian Province, from 80,000 barrels per day to 240,000 barrels per day. The upgraded refinery will primarily refine and process sour Arabian crude. In addition, new petrochemical facilities will be constructed, including an 800,000 tons-per-year ethylene steam cracker, an 800,000 tons-per-year polyethylene unit, a 400,000 tons-per-year polypropylene unit, and an aromatics complex to produce 700,000 tons per year of paraxylene. A 300,000-tons crude berth and associated utilities will also be built.
Yokogawa awarded for Package Order to Supply Control Systems for Petrochemical Complex in Singapore:

Yokogawa has received a package order from Shell Eastern Petroleum (Pte) Ltd (SEPL) to supply control systems for the Shell Eastern Petrochemicals Complex (SEPC) in Singapore. At the SEPC, SEPL is constructing a new petrochemical plant that will annually produce 800 thousand tons of ethylene and 750 thousand tons of mono-ethylene glycol and upgrading an existing petroleum refinery with a refining capacity of 500 thousand bpd. Yokogawa shall deliver the control systems using the latest FOUNDATION fieldbus technology for these upgrade and expansion projects by December 2008. The delivered systems will include the CS 3000, ProSafe-RS, Exaquantum (PIMS) and EJX.
Yokogawa awarded as main system supplier for ESSAR refinery expansion project:
Yokogawa secure the order as Main Automation Contractor & supplier of DCS, ESD and F&G system for Essar refinery expansion from 10.5 to 34 MMTPA. Yokogawa shall deliver the control systems using the latest FOUNDATION field bus technology for this expansion projects by December 2009. The Overall system supply will include the CS 3000 VP, Triconex ESD from Invensys, ProSafe-RS for F&G.
Honeywell’s 2007 Users Group Americas Symposium:  
The Honeywell 2007 Users' Group Americas Symposium was held June 10-14th in Phoenix at the Arizona Resort and Spa. A record attendance of over 1,700 people from around the world participated in the event that included a general session on industry innovations and advancements, technology and solutions update sessions, industry break out sessions, and an exposition demonstrating key Honeywell products, solutions, and services. Honeywell is also attracting a lot of recognition for their innovative highly integrated POMS and Experion PKS Batch Control System solution for the Pharmaceutical industry. In ARC’s view, the new system comes closest to meeting a full implementation of the ISA 88 batch standard.
Honeywell secure $4.7 million automation project of cement plant in west Virginia with FF:

- **Qatar Shell Improves Efficiency of GTL Plant**

Honeywell was selected by Qatar Shell GTL Ltd. to design and implement the integrated process automation system for the Pearl Gas to Liquids (GTL) plant. This includes installation of the Experion Process Knowledge System (PKS) Release 300, with FOUNDATION fieldbus communication, to tie together all critical subsystems in the plant.

With the integrated automation platform, Qatar Shell GTL Ltd. will be able to efficiently control GTL operations from production at the platforms, to processing at the on-shore plant, to shipping of the finished product.
Honeywell Signs MAC Agreement with BP Exploration & Production:
Honeywell has signed a six-year agreement with BP Exploration to provide Main Automation Contractor (MAC) services at the oil and gas leader’s new and existing facilities. Honeywell will help BP Exploration & Production (E&P) accelerate production schedules and improve efficiency in these facilities by integrating all levels of plant operations and automating critical processes. Honeywell can apply its integrated strategy to each design phase, including front-end engineering development, early operator training and process simulation, advanced control modeling, process validation and advanced process control. This integrated approach will result in common interfaces across production and business systems for increased safety and efficiency, higher plant availability, lower operating expenditures and reduced engineering.
INVENSYS IS THE SYSTEM SUPPLIER FOR RELIANCE REFINERY EXPANSION:
Invensys is the Main automation contractor and system supplier for upcoming refinery and polypropylene plant. The refinery capacity is doubled to 62.5 MMTPA with current expansion. This is state of art plant with fully automated and Foundation Field bus system in most of the control loops. The plant FF system is commissioned with advance diagnostic module from MTL. Reliance award Invensys first refinery full automation i.e. DCS, ESD, TAS, OFFSITES and Field Instruments like Transmitters. Based on past experience having Invensys system in Old refinery, Reliance extend all the full automation portfolio of Invensys to new refinery. Reliance uses Invensys Solutions like Enterprise Control system, Online Optimization package and their major New project like KGD6 also Invensys solutions are selected. JERP Expansion total Solution are extended in the same system with all new technology implemented while maintaining all old Hardware.
ABB system and Asset Master: a New Comprehensive Field Device Management and Optimization Solution: ABB introduced Asset Master, a new software solution that helps user to meet these objectives, as well as providing traditional set-up tools for instrumentation configuration and calibration. ABB system used state of art plant operation on Profibus DP for high precision Fibre production in Thailand, Pan Century Malaysia using multiple protocol for information exchange with other systems.
Field Bus: A Way Forward

Level 3
Operations

Level 2
Loop

Device

Electronics
Defective

Sensor
Drift

External influence

Drift

ESSAR
Four-Level Management Module “Abnormality Analysis”

Level 4
Enterprise Network

Level 3
Communication & Networking

Level 2
Operations

Level 1A
FF Accessories

Level 1
FF Sensors

Device

Electronics Defective
Sensor Drift
External influence

Drift
Device Level

Device Configuration:

- FF Basic-to-LM device wizard
  - “Safe” way to enable/disable Backup LAS
  - Provides wizard to step through sequence
  - Insures BLAS will work when needed
Device Level (Sensing):

Device Replacement:

- Device Replacement by Operator
- Replacement from Operator Station or Engineering Station
- Auto replacement
- Upgrading devices on-line
Device Level (Final Element):
Asset Measurement & Solutions:

• Effectiveness for diagnostic
  – Detecting inner valve failure
    • Wearing of seat ring
    • Sticking the foreign object
  – Detecting the failure by vibration
    • Moving from proper mounting position of positioner by vibration.
  – Accurate analysis (No Human error)
  – Information available at Control room (With Problem Description)
  – Stroke repetition
  – Hysteresis data, Input output deviation
  – Valve signature
  – Overshoot / Undershoot stem travel
Input/ Output Deviation

- **Basic idea**
  - Alert when the deviation between input and valve travel exceeds the threshold of time and setting deviation.

- **Effectiveness for diagnostic**
  - Stem moving degradation index by slurry or high viscosity fluid.
Stick-slip Mechanism

- Flue-gas desulfurization unit in a commercial power plant
- Stick slurry disturbs valve travel
- Cleaning is required every two weeks

Stick-slip Mechanism

Stick slurry to Guide at dead end

Stick slurry to Guide at opening

Angle Slurry Valve 2B

Guide
Uniform Hole
Plug
Plant level Communication:

**Issue with FF:**

Common issue in Electrical wiring (loose wire strands, water ingress, faulty devices, EMC, etc.)

**Bus topology connects multiple devices**
- Serial communications signal
- One fault can affect several devices

**Available tools are for conventional technology**
- Tools lacks ability to visualize Fieldbus related signals
- Locating the problem is difficult and time consuming many devices in one loop; interoperability)

**Field Bus installation**
- Tools to commission, Supervise & trouble shoot (signal distortion)
Plant level Communication:

Measurement & Online Solutions:

- Identify kind of failure & guided actions
- Grounding, Software, hardware & wiring problem
- Highlight Problem with help
- User configure warning & Alarm alerts before segment fails
- Commissioning tool
- Digital Oscilloscope function (Lost telegram)
- Log of each event at DCS / HMI
Process Level Diagnosis:

- Impulse line chocking
- pH sensor deteriorated
- Coating on probe of magnetic pickup
- Shedder bar not vibrating due to internal or external reasons
- High temperature around the devices
- Controllability problem due to process fluctuation
- Inappropriate step taken by Operator (SP not followed)
Field Bus: A Way Forward

- Reduction in Terminations: 40%
- Reduction in I/O Cards: 60%
- Reduction in Panel Space: 50%
- Reduction in # Transmitters (multi variable): 10%
- Reduction in erection hardware: 40%
- Reduction in Installation & commissioning time: 50%
- Reduction in Home run wiring: 40%
- Reduction due to remote diagnostics: > 50%
- Reduction in time to add new device: 70%
- Reduction in Calibration time: 70%
- Increase in Device cost: 10%
Loop Level Diagnosis:

![Deviation Monitor](image)

- **PV Plot**: Red line
- **SV Plot**: Blue line
- **Excellent**: Green line
- **Good**: Yellow line

Process Value vs. Time (F3022CM)
Field Bus: A Way Forward

Identity Summary
Area / Eqp Name: LINE-5
Eqp / Loop Name: FCSB141
Loop / Dev Name: T1210CN
Loop / Dev Desc: PWV-VITO PWM-V1-1 TEMP.

Deviation Monitor
Mode Monitor

From: 03/25/2008
To: 03/26/2008

Tolerance
Excellent Control(%): +/-5
Good Control(%): +/-30
Bad Control(%): Others

Value
100
0
0

Deviation Monitor
Mode MA1
Fi Plot
SI Plot
Excellent
Good
### Field Bus: A Way Forward

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ANALOG INSTRUMENTS</th>
<th>FF DEVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Valve calibration</td>
<td>3 Hrs.</td>
<td>15 Min</td>
</tr>
<tr>
<td>Transmitter calibration</td>
<td>1.5 Hrs.</td>
<td>15 Min</td>
</tr>
<tr>
<td>Termination checking</td>
<td>30 min</td>
<td>5 Min</td>
</tr>
<tr>
<td>Loop Checking</td>
<td>3 ~ 4 Hrs.</td>
<td>20 Min</td>
</tr>
<tr>
<td>Special tool required for Calibration</td>
<td>Yes, loop validator, ma source, hand tools</td>
<td>From DCS / Hand Held communicator</td>
</tr>
<tr>
<td>Device calibration &amp; parameterization</td>
<td>Calibration at Field / workshop</td>
<td>On line from HOST (DCS)</td>
</tr>
<tr>
<td>Detection of Defect</td>
<td>Mostly physical inspection at different level is required</td>
<td>From DCS Automatically Generated</td>
</tr>
<tr>
<td>Maintenance / calibration History</td>
<td>To be entered Manually</td>
<td>Automatically captured &amp; stored in DCS</td>
</tr>
<tr>
<td>Skill up Training</td>
<td>No special training</td>
<td>Additional Training needed</td>
</tr>
</tbody>
</table>
Why use Foundation Fieldbus?

Lower Total Cost of Ownership (CAPEX + OPEX)

<table>
<thead>
<tr>
<th>Capex (Hardware)</th>
<th>Opex (Plant Operations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less cabling</td>
<td>Fast commissioning</td>
</tr>
<tr>
<td>Fewer I/O ports</td>
<td>Reduced downtime - Higher process availability</td>
</tr>
<tr>
<td>Fewer cabinets</td>
<td>More data from the field</td>
</tr>
<tr>
<td>Fewer transmitters/ process penetrations</td>
<td>Increased margin from automation</td>
</tr>
<tr>
<td>Optimum DCS controller</td>
<td>Fewer people in the plant</td>
</tr>
<tr>
<td>Load by control (PID etc..)</td>
<td>Tighter quality, greater safety</td>
</tr>
<tr>
<td>In the field</td>
<td>Control flexibility</td>
</tr>
<tr>
<td></td>
<td>Increased standardisation</td>
</tr>
<tr>
<td></td>
<td>Asset management</td>
</tr>
</tbody>
</table>
Types of Fieldbus Devices That Have Been Registered

- Mass Meter
- Pressure Differential
- Pressure Absolute
- Valve Positioner
- Valve Actuator
- Rotary Valve Actuator
- Radar Level
- Mag Flow
- Digital Valve Controller (on/off)
- Digital Valve Controller
- pH/ORP
- pH
- Temperature
- Level Gauge

- Coriolis Mass Flow
- Nuclear Level Gauge
- Vortex Flow
- 2-wire In Situ O2
- Conductivity
- Conductivity / Resistivity
- Continuous Gas Analyzer
- Gas Chromatograph
- Fieldbus to Current
- Fieldbus to Pressure
- Current to Fieldbus
- Recorder
- Fieldbus Controller
- Discrete I/O

Note: See www.fieldbus.org for latest listing
Thanks