What are ConnectedProduction™ Solutions?

- Production Automation
- Fundamental Solutions
- Enabling Technologies
- Advanced Analytics and Reasoning
Optimized for rapid value creation – enabled by integrated control and information
ConnectedProduction™ Solutions

- ConnectedProduction™ solutions provide Oil & Gas producers the secure connectivity and scalability that is required to visualized and optimize production from the well head to the point of custody transfer.

- Deployed within an operations environment (on premise), or in the cloud, ConnectedProduction solutions provide a complete set of capabilities, including:
  - Visualization
  - Historical data
  - Data modeling
  - Reasoning and analytics
  - Mobility
  - Open architecture that enables third-party connectivity

- Intelligent assets provide contextualized data within a ConnectedProduction system, and can be any combination of third-party assets and intelligent assets offered by Rockwell Automation
## ConnectedProduction™ Solutions

### Functional Overview

#### Deployed “on-premise” or “in the cloud”

<table>
<thead>
<tr>
<th>Collaboration /Role Based Content</th>
<th>Asset Management</th>
</tr>
</thead>
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<tr>
<td>Data Model</td>
<td>Visualization</td>
</tr>
<tr>
<td>Workflows</td>
<td>Historical Data</td>
</tr>
<tr>
<td></td>
<td>Mobile / web</td>
</tr>
</tbody>
</table>

#### Collaboration /Role Based Content

- **Data Model**
- **Visualization**
- **Historical Data**
- **Reasoning**
- **Workflows**
- **Mobile / web**

#### Data Connectors / Gateways

- **OptiLift™**
- **OptiSIS™**
- **Turbo Machinery Control**
- **OEM**
- **Intelligent Assets**
- **Infrastructure**
- **DCS / SIS**
- **RTU**
- **Field Devices**
- **Device Assets**
- **Data Repository**
- **Application Interfaces**

#### Devices (and third-party systems)

- **Intelligent Asset**
- **Control**
- **Information**
- **Safety**
- **Power**

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ConnectedProduction™ Solutions
On-Premise Architecture

Simplex (default), redundant and high availability options available

- Industrial Data Center (IDC) E2000
- FactoryTalk® VantagePoint EMI server and client
- FactoryTalk® View server and client
- FactoryTalk® Historian SE
- FactoryTalk® ViewPoint Client
- OPC Server (KEPWare and/or RSLinx®)

Well Pad – up to 32 wells

Artificial Lift

Flow

Monitoring

Logix (MTU)

RTU

RTU

Production Automation

OptiSIS™

Production Safety

AADvance®

EtherNet/IP

Modbus

Scalable Architecture
ConnectedProduction™ Solutions
On-Premise Large Architecture

Simplex (default), redundant and high availability options available

- Industrial Data Center (IDC) E2000
- FactoryTalk® VantagePoint® EMI server and client
- FactoryTalk Historian SE
- Pi-to-Pi connector

Scalable Architecture

EtherNet/IP
Modbus

On-Premise Architecture (up to 500 assets)

OPC Server (KEPware and/or RSLinx®)
ConnectedProduction™ Solutions
Cloud Architecture

Rockwell Automation® Cloud (Microsoft Azure)

Well Pad – up to 30 assets

Scalable Architecture

Artificial Lift

Logix (MTU)

Logix

OptiSIS™

AADvance®

Production Automation

Production Safety

Rockwell Automation® Cloud

Gateway

Gateway

Gateway

Gateway

Gateway

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Gateway
ConnectedProduction™ Solutions?

Security

Hosting & Analytics

LAN, WAN Wireless, Cell Satellite

Field Assets

Off Premise

- Integrated Key Management
- Isolated Customer Data Storage
- Role Based Authentication
- Geo Locked Authenticated Gateway
- Secure Unidirectional Communications Over Port 443
- Cloud Gateway

On Premise

- ISA99 ISA/IEC 62443
- Industrial Data Center (IDC) E2000 FTVantagePoint EMI Server & Client
- FTView Server & Client
- FTHistorian SE
- FTViewPoint Client
- OPC Server (KEPWare &/or RSLinx)
- IPSec/GREVPN
- Secure Bidirectional Communication over Select Ports
- Secure Services Router

MPLS VPN

Cloud Gateway

Collaborative Security

Isolated Customer Data Storage

Integrated Key Management

Connected Production ™ Solutions?

Security

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- Isolated Customer Data Storage
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MPLS VPN

Cloud Gateway

Collaborative Security

Isolated Customer Data Storage

Integrated Key Management
**Scalable HMI Solutions**

Scale from single station to multi-client / multi-server systems

- Create custom process graphics, as required
- Customize pre-defined graphics, as required
- Create alarms unique to implementation
- Create reports, per project requirements

---

**FactoryTalk® View SE**

- Configure your application from anywhere on the network and easily make changes to a running system with remote, multi-user configuration capability
- Scalable Architecture from single station HMI to multi-client/multi-server system
- Maximize system availability with built-in failure detection and recovery
- Robust client side scripting to extend applications for your specific needs
- Built-in library of over 5000 pre-designed graphical symbols
- Built-in security model, linked to existing IT infrastructure
ConnectedProduction™ Solutions

Workflows

- Define implementation-specific workflows
- Implement, and integrate workflows into Connect Production
- Integrate implementation-specific producers/consumers of workflow data

- Configurable workflows
  - Standard environment, supports custom workflows
  - Facilitates workflow execution (persistence, multiple instances, etc.)
  - Built on off-the-shelf technology

- Designed for any stakeholder
- Capable of acting on data from any data source within the system

- Model driven, configurable workflows support various use cases, for example:
  - Initiated by ERP (SAP)
  - Initiated by User (SOP)
  - Initiated by Event (i.e., process condition)

- Predefined ConnectedProduction™ Activities (building blocks to define customized workflows)
ConnectedProduction™ Solutions

Reasoning

- Define interfaces
- Integrate third-party models
- Define and implement visualization, reports, workflows, etc.

- Open architecture allows for integration of third-party analytics, reasoning, production modeling, etc.
- Can be integrated, via plug-in, directly into the well type model, providing data context
- Preferred connectivity can be achieved by implementing a native data connector
- Can have multiple analytics engines within a system
- Resulting data set can be utilized in:
  - Visualization
  - Workflows
  - Any system with access to model
FactoryTalk® AssetCentre

**Version Control / Source Control**
- Centrally store files – programs, configurations, SOPs, CAD documents, and more
- Automatic version control helps ensure proper file management
- Maintains single master relationships
- Allows for additional users to get a copy while maintaining the master ownership

**Audit Trail**
- Audit / Event messages include logged time, time of occurrence (when), user name (who), device, computer name (where) and action taken (what)
- Scheduled automatic backup of plant-floor asset configuration

**Disaster Recovery**
- Optionally compares the backup configuration against an archived version
- Latest or specific version
- Pinned version
- Create version when difference detected
- Difference report in Event database, and email

- Define implementation-specific assets
- Implement desired asset management features (for example, disaster recovery)
Agenda

What are ConnectedProduction™ Solutions?

Production Automation

Fundamental Solutions

Enabling Technologies

Advanced Analytics and Reasoning
Production Automation
Well Manager Solution

- **Scalable Multi-Well Control:**
  - ControlLogix® based - for large sites with up to 32 artificial lift wells
  - CompactLogix™ based - for small sites with up to eight artificial lift wells
  - Incorporates Allen-Bradley® Flex™ I/O, PowerFlex® VFD, and OptiLift™ artificial lift technologies

- **Configure and Run Artificial Lift and Optimization:**
  - Sucker Rod Pump (SRP)
  - Plunger Lift
  - Gas Lift
  - Electric Submersible Pump (ESP)
  - Progressive Cavity Pump (PCP)
  - Natural Flow
  - Black Oil Model, Well Test, Tank Management, and so forth.

- **Configure and Run Electronic Flow Metering:**
  - Custody Transfer metering for Gas and Liquids
  - Up to 80 flow runs

- **EtherNet/IP Production Automation Network:**
  - Connects to Modbus field devices and third-party controllers
Production Automation
Well Manager Solution

Oil & Gas applications in Logix configure and run
- Rod Pump Controller
- Plunger Lift
- Gas Lift
- Electric Submersible Pump
- Progressive Cavity Pump
- Natural Flow

- Configure and run HMI applications for artificial lift operations and electronic flow measurement.
## Production Automation
### Intelligent Assets

<table>
<thead>
<tr>
<th>Oil &amp; Gas Extraction</th>
<th>Enhanced Recovery</th>
<th>Power Control</th>
<th>Fiscal Measurement</th>
<th>Treatment &amp; Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Wellhead automation</td>
<td>▪ Injection pump controls</td>
<td>▪ LV / MV drives</td>
<td>▪ LACT unit control</td>
<td>▪ Gas treatment and compression</td>
</tr>
<tr>
<td>▪ Natural lift systems</td>
<td>▪ Injection manifolds controls</td>
<td>▪ Electrical control house</td>
<td>▪ TMC / Compressor control</td>
<td></td>
</tr>
<tr>
<td>▪ Artificial lift systems</td>
<td>▪ Chemical storage</td>
<td></td>
<td>▪ Oil treatment and storage</td>
<td></td>
</tr>
<tr>
<td>▪ Injection systems</td>
<td>▪ Treating liquids blending</td>
<td></td>
<td>▪ Produced water treatment and storage</td>
<td></td>
</tr>
<tr>
<td>▪ Safety systems</td>
<td>▪ process control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Separation systems</td>
<td>▪ Steam generation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Gas compression</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Production Automation
SCADA, DOF, Intelligent asset auto discovery

OptiLift™ roadmap of intelligent assets for artificial lift
- OptiLift™-WM (Well Monitoring)
- OptiLift -NF (Natural Lift)
- OptiLift-ESP (Electrical Submersible Pump)
- OptiLift-PCP (Progressive Cavity Pump)
- OptiLift-RPC (Rod Pump Controller)
- OptiLift-GL (Gas Lift)
- OptiLift-PL (Plunger Lift)

1. ConnectedProduction™ services, automatically, detects a new asset
2. User is prompted with “Asset Discovery” wizard
3. User is guided, step by step, to configure:
   - Name
   - Description
   - Location details
4. Asset is available for use

Add Asset (Manual or System)  Auto Discover
Create Polling Engine Tags
Create Historian Tags
Create Visualization
Create linkage to third party applications (e.g. Analytics, Asset Management)
Create Workflows
Engineered to comply with IEC61508/IEC61511 safety manuals.

- SIL3, Fail-Safe or Fault Tolerant hardware configurations
- 50 and 100 I/O sizes available, Universal inputs
- Simple, intuitive, configurable, cause and effect configuration interface
- Configure safety functions – no programming required.
- Available in either safe area (NEMA 4/IP54) or hazardous area (NEMA 4X/IP66) enclosure
- Excellent choice to migrate legacy safety solutions not compliant with IEC61508/IEC61511
- Cost effective process safety solution
Agenda

What are ConnectedProduction™ Solutions?

Production Automation

**Fundamental Solutions**

Enabling Technologies

Advanced Analytics and Reasoning
Fundamental Solutions
Artificial Lift Operations

Sucker Rod Pump
Plunger Lift
Natural Flow
Gas Lift
Progressive Cavity Pump (PCP)
Electric Submersible Pump (ESP)
Artificial Lift Optimization Intelligent Assets:
- Rod Pump Control (complete)
- Plunger Lift (in progress)
- Gas Lift
- Natural Flow
- Electric Submersible Pump
- Progressive Cavity Pump

ConnectedProduction™ Well Manager
(licensable components)

OptiLift™ Packaged Solutions
(Standalone)
Fundamental Solutions
OptiLift™ WM (Well Monitor)

Features:
- High-performance iRecv RTU Gateway to SCADA System
- Long range iSens wireless pressure and temperature transmitters
- Provides real-time data monitoring and reliable local well shutdown control
- Configurable Alarm Logic for alarming and local control
- Custom Enclosure option
- Solar Power option

<table>
<thead>
<tr>
<th>Analog Logic ID</th>
<th>Left Tag ID</th>
<th>Logic Operation</th>
<th>Right Tag ID</th>
<th>Deadband</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>T3</td>
<td>&gt;</td>
<td>T8</td>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>A2</td>
<td>T2</td>
<td>&lt;</td>
<td>T9</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>T5</td>
<td>=</td>
<td>T15</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td>A4</td>
<td>T1</td>
<td>&gt;=</td>
<td>T9</td>
<td>0</td>
<td>X</td>
</tr>
</tbody>
</table>
Fundamental Solutions

OptiLift™ PL (Plunger Lift)

- Optimizes lifetime of well by mitigating the effects of liquid loading
- Designed for deployment on gas and gas/oil wells
- Can be installed to existing mechanical plunger systems (500,000 gas wells in the U.S.)
- Supports six operating modes
- "Self" learning, adapts / tunes to well conditions
- Protects well during abnormal situations
- Records production data sets at multiple intervals (daily, monthly, lifetime)
- Licensable component of Well Manager
- Designed for interface with ConnectedProduction™ services
- Stand alone OptiLift™-PL, available soon
Fundamental Solutions
OptiLift™ RPC (Rod Pump Controller)

- Supports six modes of operation:
  - Fixed Speed (standalone)
    - Pump off (POC)
    - Time based
    - Manual
  - Variable Speed (Allen-Bradley® Drive, or third-party drive)
    - Pump off (POC)
    - Pump Fillage
    - Manual
- Dynamometer card that is based pump-off control (requires load cell and inclinometer)
- Continuous true load and position monitoring
- Calculated down hole card
- Real time well problem detection and load violations
- Well production performance statistics
- Various pre-designed power options
  - Drive sizes ranging from 25 hp to 125 hp
  - Traditional dynamic braking
  - Energy-efficient Active Front End (IEEE519)
ProSoft AFC Flow Computer

- **Measurement** of hydrocarbon gases and liquids using currently accepted industry measurement standards
- **Archiving** for each meter run, hourly for two days (up to 35 days optional) and daily for one month (35 records) under default configuration.
- **Process Variables** may be in-chassis analog I/O, distributed I/O, iSens transmitters, or third-party transmitters
Agenda

What are ConnectedProduction™ Solutions?

Production Automation

Fundamental Solutions

Enabling Technologies

Advanced Analytics and Reasoning
Enabling Technologies
Allen-Bradley® PLCs and PACs

Scalable Controller Portfolio
- Up to 32 artificial lift wells
- Up to 80 flow runs

Robust Network Infrastructure
CISCO technology and EtherNet/IP
with redundancy options at every level

Comprehensive Integration
The broadest range of traditional I/O and intelligent devices
## Enabling Technologies

### Intelligent RTUs

- High performance RTU with PLC-like features
- IEC 61131 programming with ISaGRAF Workbench
- Embedded web server
- Gateway for up to 100 rDAC transmitters
- Embedded web server

### Low-power consumption RTU

- AGA 3, 7, and 8 API 21.1 compliant gas flow metering
- Plug-and-play radio module for telemetry applications
  - *Programmable Sleep Interval, and Transmit Interval*

<table>
<thead>
<tr>
<th>Feature</th>
<th>8-28Vdc, 4 W</th>
<th>7–30 Vdc, 350 mW continuous, 0.45 mW in sleep mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>800 MHz</td>
<td>32 MHz</td>
</tr>
<tr>
<td>Ports</td>
<td>(2) 10/100 Ethernet Ports, (2) RS-485 ports, (2) RS-232 ports, USB host port</td>
<td>(2) 10/100 Ethernet Port, (2) RS-485 ports, RS-232 port, USB port, I2C port</td>
</tr>
<tr>
<td>DI</td>
<td>(8) DI sinking, (8) DO sinking, rated 500 mA, (1) DI hardware interrupt</td>
<td>8 DI sinking (one DI is HSC), 8 DO solid-state relay rated 350 mA</td>
</tr>
<tr>
<td>AO</td>
<td>(2) AO 12 bit (0-5 Vdc or 4-20mA)</td>
<td>1 RTD input, 12 bit, 100 ohm platinum</td>
</tr>
<tr>
<td>AI</td>
<td>(8) AI 24-bit (0-5 Vdc, 4-20mA), (2) AO 12-bit (0-5Vdc or 4-20 mA)</td>
<td>Optional Pluggable Wireless Card (900 MHz and 2.4 GHz)</td>
</tr>
</tbody>
</table>
### Enabling Technologies

**Wireless Transmitters**

- Long-range embedded wireless communications
- No external power required
- Configurable Sleep Interval, and Transmit Interval
- Data is pushed to data concentrator

---

**iSensMV**
- Multivariable transmitter that measures absolute and differential pressure, and temperature.
- Seven ranges available with DP to 840" H2O, AP to 1,500 psia.
- 900 MHz or 2.4 GHz radio
- Wired version available.

**iSensGP**
- Gauge pressure transmitter.
- Five ranges available, up to 10,000 psi.
- 900 MHz or 2.4 GHz radio

**iSensDP**
- Transmitter that measures absolute pressure and differential pressure.
- Five ranges available, up to 3,000" H2O available.
- 900 MHz or 2.4 GHz radio

**iSensT2**
- Temperature transmitter with
- -17°C to 200°C range (0–392°F)
- 900 MHz or 2.4 GHz radio

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# Enabling Technologies

Wireless Data Acquisition RTUs and Gateways

<table>
<thead>
<tr>
<th>iXS8</th>
<th>iSensIO</th>
<th>iRecv</th>
<th>iExtnd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Acquisition RTUs</strong></td>
<td><strong>Configurable sleep interval</strong></td>
<td><strong>Wireless Transmitter to Modbus Gateway</strong></td>
<td><strong>EtherNet/IP to Modbus TCP Gateway</strong></td>
</tr>
<tr>
<td><strong>Battery Powered (no solar required)</strong></td>
<td><strong>Configurable transmit interval</strong></td>
<td><strong>Wireless Repeater</strong></td>
<td><strong>Achilles certified EtherNet/IP to Modbus TCP converter. Supports RTUs and third-party Modbus TCP devices.</strong></td>
</tr>
<tr>
<td><strong>Embedded Wireless Communications</strong></td>
<td><strong>(6) AI, 12 bit (0-5Vdc, 4-20 mA)</strong></td>
<td><strong>RTU function via Embedded I/O</strong></td>
<td><strong>(2) independent TCP ports</strong></td>
</tr>
<tr>
<td><strong>Wireless Transmitter to Modbus Gateway</strong></td>
<td><strong>(1) AO, 12 bit(0-5Vdc,4-20mA)</strong></td>
<td><strong>EtherNet/IP Class 1: Add RTU into Logix I/O tree (AOP)</strong></td>
<td><strong>Buffers events / trends</strong></td>
</tr>
<tr>
<td><strong>Wireless Repeater</strong></td>
<td><strong>(2) DI, (3-24 Vac or Vdc)</strong></td>
<td><strong>EtherNet/IP Class 3: Polling from Logix (MSG), exception reporting from remote site.</strong></td>
<td><strong>(1) AO for battery level</strong></td>
</tr>
<tr>
<td><strong>RTU function via Embedded I/O</strong></td>
<td><strong>(1) DI event driven interrupt</strong></td>
<td><strong>(2) DO</strong></td>
<td><strong>(1) AI for battery level</strong></td>
</tr>
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<td><strong>Wireless Repeater</strong></td>
<td><strong>(2) DI (3-24 Vac or Vdc)</strong></td>
<td><strong>(1) AI for battery level</strong></td>
<td><strong>(1) AI for temperature</strong></td>
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<tr>
<td><strong>RTU function via Embedded I/O</strong></td>
<td><strong>(1) DI event driven interrupt</strong></td>
<td><strong>(2 AI for battery level</strong></td>
<td><strong>(1) A/D channel for RTD</strong></td>
</tr>
<tr>
<td><strong>Wireless Repeater</strong></td>
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<td><strong>(1) AI for temperature</strong></td>
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<td><strong>Wireless Repeater</strong></td>
<td><strong>(1) AI for battery level</strong></td>
<td><strong>RS232/RS485 serial port</strong></td>
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Agenda

What are ConnectedProduction™ Solutions?

Production Automation

Fundamental Solutions

Enabling Technologies

Advanced Analytics and Reasoning
Advanced Analytics and Reasoning
SCADA, DOF, and RPC analytics

- The OptiLift™ RPC measures surface conditions and calculates down hole conditions, producing surface and downhole cards
- ConnectedProduction™ RPC analytics, analyzes the condition of the well and pump, which is based on downhole card
- ConnectedProduction RPC analytics, monitors the shape of the down hole card and identifies:
  - The work that is done by the pump
  - The pump fillage
  - Fluid pound conditions
- Predict probability of failures, by failure mode
Advanced Analytics and Reasoning
Flow Measurement, Virtual Flow Metering

Configuration
- Base Assay Coefficients
- Water Cut
- Initial Well Test Data
- Base PVT Data
- Well characteristics
- Reservoir Data

Measured Values
- Casing Pressure
- Casing Temperature
- Tubing Pressure
- Tubing Temperature

Black Oil Model
- Computes three-phase flow (oil, gas and water) based on well configuration, and measured pressures and temperatures
- Produces / generates:
  - Well profile – P, T, flow regimes
  - Well frictional and elevation pressure drops / pressure profile
  - Well temperature profile
  - Well performance curves / parametric
  - Well operating envelope (next phase)

Well
- Provides well performance analysis:
  - Forecasting aid, what-if analysis, and performance improvement
  - Parameter impacts: for example, water-cut, reservoir pressure, and PI
- Enables well test cross-check / validation
- Infers values between well tests, improving production accuracy and providing early problem detection
- Enables “test by exception”, streamlining well test scheduling
- Does not require a three-phase meter
- Works on a broader range of conditions vs. three-phase meter