Advanced Digitalization for Agile Project Execution

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Scenario

• Products and Projects
  – Product developments according to technological improvements and marketing strategies
  – Project execution according to best engineering practices

• Not enough any more:
  – Technological developments to favor efficient/flexible project execution and minimize risk
  – Make use of IIoT technologies (Cloud Enabled Execution, Virtual Testing, Flexible Binding, Bulk Engineering, ...)

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APEX in a nutshell

Why change the current Execution Model?
- Drive from Industry: Get automation off the critical path
- Customers Reduce CAPEX budget: Focus on Capital Efficiency
- Apply Enabling Technologies: Smart IO & Virtualization

- Design standardization & modularization to save cost
- Reduce project schedule risks by removing hardware and software inter-dependencies (decoupling)
- Improve Commissioning workflow with remote support
- Execution Flexibility and Lifecycle Management

Agile Project EXecution
Customer expectations for Industry specific issues

**Challenges**
- Reduce unnecessary work
- Minimize customization
- Validate software without HW FAT
- Prevent design recycle and HW/SW rework
- Minimize unnecessary HW
- Eliminate / minimize physical, data & schedule dependencies
- Simplify 3rd party package I/F configuration
- Accommodate change easily & less impact
- Less effort in Alarm management & Cyber Security
- Reduce effort of Documentation
- Challenge traditional approaches

**Approaches**

### Smart Engineering
- Re-usable Applications
- Secure Remote Testing
- Smart JB designs
- Virtualization

### Delivery Excellence
- Consistent Risk Mitigation
- Knowledge Management
- LEAN execution
- Basic Design Toolkit

### ICSS Technology
- Networking
- Modularity/Standards based Design
- Independent (parallel) phases
- Flexible Binding at site
- Built-in Management of Change

**Generic Benefits**
- Predictable and modular Engineering
- Optimized Engineering and Space Utilization
- Minimize Travel (Reviews, Testing, Validation)
- Optimized project execution
- No Engineering Surprises
- Validated & proven Integration
- Early Plant Startup
- Easy Modification
- Reduced Footprint

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AGILE PROJECT EXECUTION
Benefits: Removing waste and Reducing cost
What is our approach
APEX, Removing waste and Reducing cost in all Projects

Our Approach

Next Generation Platform
Delivery Excellence
Smart Engineering

Customer Benefits
Removing Waste and Minimize Customization
Flexible Binding and Later Changes
Lowest Cost, Consistent Quality

Agile
Project Execution

APEX

Smart Engineering

CONVERGENCE

ICSS technology

Delivery Excellence
APEX Smart Engineering

Customer Benefits

- Predictable Engineering, No Engineering Surprises
- Optimize Space Utilization (Power, Weight, Cooling)
- Minimize Travel (Reviews, Testing, Validation)
- Separating Logical from Physical

Our Approach

- Module (class) based engineering
- Re-usable Applications
- Standard Panels
- Global PC
- Preconfigured switches
- Virtual (remote) test
APEX Smart Engineering

Cloud Enabled Execution
Securely collaborate with anyone, anywhere and anytime across the globe with yi-CLOUD
APEX Smart Engineering

Today

- Shortages of num of H/W resources
- Difference of REV
- Schedule adjustment
- Maintenance of H/W
- Power consumption
- Upon finishing the work, need to return resources immediately

Decrease the time and expenses dramatically

yi=CLOUD

VES

Data Library

Copy VMs fast & easily
Utilize Data Library
Create more VMs, using less resources,
Save VMs with them being terminated after finishing work,
Simplify administering machines

Remote engineering from his/her own desk.
Utilize multiple VMs (avoid multiple rev issues)
Enable restart/shutdown remotely

Smart Engineering

ICSS technology

Delivery Excellence

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APEX Smart Engineering

Fortinet 1000D (F/W)

(1) SSL-VPN connection with ID & PW to IP “A”

Office LAN

(2) RDP Connection

IP: A

(1) SSL-VPN connection with ID & PW to IP “B”

Project A network

VLAN A

Virtualization Servers

Separate Network

VM

VM

VM

VM (DB)

Project B network

VLAN B

VM

VM

VM

VM (DB)

Manual Backup

Automated Backup

External NAS

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Smart Engineering

ICSS technology

Delivery Excellence
APEX – Technology

Customer Benefits

• Early Plant Startup
• Easy Modification
• Reduced Footprint

Our Approach

• Network-IO
• System Independent Loop Check (without FCS CPU)
• Flexible Binding at site
• Built-in Management of Change

I/O Backplane

Universal I/O Module
• 16 Channels IO
• Signal: AI/AO/DI/DO
• Software Configurable
• HART 7 Support
• Full Redundancy

Signal Conditioner (Optional)
• Wide range of I/O
• Pulse, Relay, DO, etc.

Termination Block

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No need for Marshalling Cabinets!

Marshalling – FIO

Marshalling – N-IO
Field Wiring Reduction by Smart JB

- Prefabricated System Cable
- Terminal Board
- Terminals
- Duct
- Marshalling - FIO
- Homerun Cable
- Instrument JB
- LCR
- Field

- FO Cable
- Smart JB – N-IO
- Smart IO
- LCR
- Field

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## N-IO for Hazardous Applications

<table>
<thead>
<tr>
<th>Non-IS</th>
<th>Intrinsic safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-IO</td>
<td>IS base plate</td>
</tr>
<tr>
<td></td>
<td>H-System</td>
</tr>
</tbody>
</table>

- **Yokogawa**
- **P+F**
- **MTL**

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APEX Delivery Excellence

Customer Benefits

• Minimize Waste
• Robust time management
• Validated & Optimized Integration

Our Approach

• Consistent Risk Mitigation
  • Standard Panels
  • Global PC
  • Preconfigured switches
• Functional Safety Management
• LEAN execution based on 3R
• Basic Design Toolkit

LEAN: reduce waste through innovation
3R: Right people, Right location, Right timing

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Solution platform that exceeds the capabilities of conventional production control systems

Conventional Execution
- Design
- Configuration
- Application & HW FAT
- Ship & Install
- Field wiring
- Site Activity (incl. Loop check)

Agile Project Execution
- Design
- Configuration
- Application AFAT
- Site Activity
- Manufacturing & HFAT
- Ship & Wire
- Loop Validation

Increasing quality and Reduce waste
- The class module effect
- N-IO Solution effects
- FieldMate Validator effects

HFAT: Hardware FAT
AFAT: Application FAT

Shorter project execution
Tolerate delays in project execution

**Solution platform**
that exceeds the capabilities of conventional production control systems

Conventional Execution

- Design
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Agile Project Execution

- Design
- Configuration
- Application AFAT
- Site Activity

Increasing quality and Reduce waste

- The class module effect
- N-IO Solution effects
- FieldMate Validator effects

Later Start

Reducing risks of handover slippage

HFAT: Hardware FAT
AFAT: Application FAT
Tangible APEX Benefits
APEX and how we deliver DIFFERENTIATING value

**APEX:** Competitive Project Execution model applicable to all projects

**Apex Generation Platform:**
- **ADSuite** Automation Design Suite Master Database
- **Network-IO** Universal I/O and signal conditioner
- **Validator** FieldMate Validator N-IO loop commissioning software
- **Integration** DCS-ESD, DCS-subsystems

**Agile Project EXecution**

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CENTUM VP R6 ADSuite
New Engineering Environment Benefits
Technologies and tools used in APEX

- Architectural Design
- Application Software Development and Testing
- Hardware Manufacturing
- Total System Verification
- SAT & Loop Check
- Start-up

Yokogawa Standard Cabinets & N-I/O JB’s

FieldMate Validator

PRM Commissioning Support Package

Yokogawa Standard Design Documents

Yokogawa Standard Industry Libraries

Library Repository

Automation Design Suite

Module Engineering

Bulk Engineering

Change Management

Auto Doc Generation

Flexible Binding

PRM Commissioning Support Package

iDefine for SIS/FGS Engineering

Yokogawa Standard Design Documents

Yokogawa Standard Industry Libraries

Library Repository

Automation Design Suite

Module Engineering

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iDefine for SIS/FGS Engineering

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iDefine for SIS/FGS Engineering
Class, Instantiation, Module binding

- **Class module**
- **Class-based Application module**
- **Classless Application module**
- **Drawing module**

- **Instance List**
- **Module binding**

- **Module Binding Window**
ADSuite: Modular Engineering ....... Anywhere

Modular Application Logic

- PIC001
- PT001
- PCV001
- XY001
- SEQ
- XI001

Global Application Repository

Yokogawa Standard Design Documents
Yokogawa Standard Industry Libraries

Library Repository

Module Libraries

- MACToolkit
  - O&G process
  - System Integration
  - Alarm suppression

- Power
  - OCCP process
  - VGB

- Fertilizer
  - Ammonia
  - Urea

- Sub-sea

- Batch

- Others
ADSuite + N-IO = Flexible Binding

Flexible Binding

Modular Application Logic

PT001
PCV001
XY001
XI001

faceplate

PID

Sequential Control

HIS (OWS)/ENG

Vnet/IP

Project Database

ADSuite Automation Design Master Database

NIO1 Ch.1
AI: PT001
NIO1 Ch.2
AO: PCV001
NIO1 Ch.3
DO: XY001
NIO1 Ch.4
DI: XI001

NIU

NIO

Ch.1
Ch.2
Ch.3
Ch.4

N-ESB Bus

FCU (CPU)

NIU

ADSuite N-IO Software Configuration Table

PT001
PCV001
XY001
XI001

DO: XY001
DI: XI001

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SILC: System Independent Loop Commissioning

**Factory work without I/O**
- Application coding by using labels
- Application FAT

**Site work without HMI and Controller**
- Install and wiring
- Devices parameter setting
- I/O check

**Controller**

**HMI**

**Concurrent work**

**STEP 1**
- Device parameter setting & loop check

**STEP 2**
- Generate reports automatically

**STEP 3**
- Get I/O Tags & information
- Return fixed I/O information

**STEP 4**
- I/O'"
Avoiding Project Delays

Reduce delays and be assured of starting production on schedule

Application validation during FAT

Virtual I/O wiring

Designed & constructed on site

Last minute software marshaling

Smart Configurable IO

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Integration
Different Field Digital Communication Protocols

- **ALP121** PROFIBUS-DP Module
- **ALF111** FOUNDATION fieldbus Module
- **HART I/O Module**
- **A2EN402/404** N-ESB Bus Coupler Module
- **ALE111** Ethernet Communication Module
Operate and monitor your sub-systems in **CENTUM**, like **CENTUM**.

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**UGS**

*Unified Gateway Station*

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**Sub-systems**

- Modbus RTU
- Modbus TCP
- OPC DA/A&E
- Ethernet/IP
- IEC 61850
- STARDOM

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**Graphic**

**Trend**

**Tuning**

**Alarms**

... and more
• Simple Architecture
  – Just add one more UGS2 with same configuration (such as Vnet/IP address) for redundant communication.
  – No extra software license is necessary for redundant configuration.
  – No FT (Fault Tolerant) Server, no extra L2 switches, no shared disk as HA cluster are necessary.
“Optimal” integration with subsystems

**Sub-system communications**
- Data for HMI: OPC Client (redundant) workstation can manage up to 100,000 TAGs
- Data for control logic: put (redundant) link module in one rack of the related CPU
- Integrated Control + Safety system provides optimization + performance at the same time

<table>
<thead>
<tr>
<th>Benefits</th>
<th>UGS</th>
<th>Distr. communication modules</th>
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<tbody>
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</tr>
<tr>
<td>Lower Controller CPU load</td>
<td>UGS</td>
<td>Simple reliable industrial solution</td>
</tr>
<tr>
<td>High throughput</td>
<td>UGS</td>
<td>Subsystem data directly available in DCS controller for control/logic functions</td>
</tr>
<tr>
<td>Multiple protocols</td>
<td>UGS</td>
<td>- A&amp;E by OPC A&amp;E</td>
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<th>Drawbacks</th>
<th>UGS</th>
<th>Distr. communication modules</th>
</tr>
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<tbody>
<tr>
<td>Unreliable IT technology</td>
<td>UGS</td>
<td>Affecting Controller CPU load (to be distributed among the DCS controllers)</td>
</tr>
<tr>
<td>Subsystem data NOT directly available in DCS controller for control/logic functions</td>
<td>UGS</td>
<td>Not supporting A&amp;E with timestamps</td>
</tr>
</tbody>
</table>

**Modbus / Profibus**
- Redundant Configuration is available.

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**Table**: Comparison of UGS and Distr. communication modules

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**YOKOGAWA**
Integration with Safety System

- Plant Asset Management
- Human Interface Station
- Engineering Station
- Plant Information Management

- Vnet Router
- Engineering Station
- 3rd party system Subsystems
- Unified Gateway Station
- Safety Control Stations
- Real Time Control Network Vnet/IP

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Safety System Integration

- DCS and SIS are 'truly integrated'
  - SIS and DCS data are within the same window
  - SIS data can be used in the FCS
  - Sequence of Event (SOE) data from the SIS and DCS are integrated
User can directly implement C&E diagram which is automatically converted into FBD by just clicking ‘Graphic View’ tab.
FBD generated from C&E Module

Auto-converted FBD

Logic can be added in auto-converted FBD

→ shown as ‘F(x)’ in C&E

Exported to excel spreadsheet
Summary
## From Waterfall to Agile

<table>
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<tr>
<th>WATERFALL</th>
<th>FAST TRACKING</th>
<th>AGILE</th>
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<tr>
<td><img src="image" alt="Waterfall Process" /></td>
<td><img src="image" alt="Fast Tracking Process" /></td>
<td><img src="image" alt="Agile Process" /></td>
</tr>
</tbody>
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**WATERFALL**
- Scope completely defined at the beginning;
- Customer and project team have the complete knowledge;
- Project planned from the beginning;
- A unique final deliverable;
- No interaction with the customer;

**FAST TRACKING**
- Scope kept partially open;
- Overlapped phases;
- Shorter cycles;
- More interaction with the customer;
- Partial deliverables.

**AGILE**
- Scope kept open;
- **Iterations** based for continuous results delivery;
- Team integrates the customer;
- Focus on delivering value to customer;
- Team made up of individuals with cross-functional skills, self-organized.

Source: IaSalle Almere
## Conclusion: APEX Value by phase

### FEED
- **Single Point of Responsibility**
- **Standard** Design of Cabinets, reduced Rack-room space
- **Standard Functional** Design of Application
- **Standard Design** of smart JB’s, optimized cable routing

### Execution
- **Reduce** Execution dependencies
- Getting ICSS off from Project critical path
- **Reduce** engineering complexities and improved quality
- **Simplify** documentation
- **Reduce** footprint and cabling related work
- **Reduce** travel

### Testing / Commissioning
- **Flawless Start-up & Commissioning**
- Flexible binding
- **More time for** Application software and System (CPU) cabinets shipments
- **Reduce** construction and Commissioning effort
- **Ease of Bulk changes**, **Management of change**, Auto documentation etc.
- **Shorter loop checks** and standard commissioning procedures

### Operations
- **Reduce Total Cost of Ownership**
- **Maximize Lifecycle value**
- **Reduce maintenance effort**
- **Maintain latest documentation**
ICSS for APEX: Overview

- N-IO, AD-Suite, FM-Validator
  - Flexible Binding
  - SILC: System Independent Loop Commissioning
  - Smart Junction Box

- AD Suite
  - Module based engineering
  - Separation between logical and physical
  - Bulk Generation
  - Auto Documentation with Module
  - Industry Library (DCS/SIS)

- Standardization
  - Standard Cabinet / Hardware Design
  - Global PC
  - Preconfigured network Switches

- Integration
  - Smart and flexible integration with subsystems (UGS)
  - Complete DCS-SIS integration (CentumVP+ProsafeRS)
  - Easy configuration from C&E diagrams (iDefine)
  - Structured Systematic Approach for FSM requirements (Yokogawa)
Thank you