THE INDUSTRIAL SOFTWARE REVOLUTION BEGINS NOW
Increased Operational Effectiveness with Situational Awareness

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New Release!

Situational Awareness
Many Names – Same Intent

High Performance HMI
Abnormal Situation Management (ASM)
Operator/User Centered Design
Situation(al) Awareness
Advanced Process Graphics
Human Factors Design
More...
HMI Evolution/Current State

1970’s
1980’s
1990’s
Present

- Safe
- Reliable
- Efficient
- Effective
HMI/Supervisory Market Spectrum

**Key Needs/Aspects**
- Ease of Use
- Process Visualization
- Basic Alarming
- Short Term History
- Device Connectivity
- Larger Tag/Graphic Counts
- Graphic Standards
- Extensible Vis (Client Controls)
- Basic Reporting
- Basic Alarm Management
- Server Consolidation
- Standard Equipment Model
- Thin Client
- Centralized Historian
- Fault Tolerance
- Situational Awareness
- Multi-Plant HMI/Common Control Room
- Advanced Alarm Management
- Large Engineering Teams
- Common Standards
- Monitoring
- Operational Centers
- PIMS (Information Management)

**Scale of Solution**

**Cumulative**

**SA Relevance**
- Medium
- Medium
- High
- Very High
- Very High
Impact of Human Error

Abnormal Situation
A disturbance or series of disturbances in a process that cause plant operations to deviate from their normal operating state.

The average percentages shown had the following:
• People and work Context Factors: 35% - 58%
• Equipment Factors: 30% - 45%
• Process Factors: 3% - 35%

Source: ASM Consortium
### Contributing Factors to Human Error

HMIs are not new so why is this an issue now?

<table>
<thead>
<tr>
<th>Trend</th>
<th>Operator Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants are larger, more complex</td>
<td>• Increased Monitoring Load</td>
</tr>
<tr>
<td></td>
<td>• Lack of Understanding</td>
</tr>
<tr>
<td>Increased Levels of Instrumentation</td>
<td>• More Data to Manage</td>
</tr>
<tr>
<td></td>
<td>• Lost in the Details</td>
</tr>
<tr>
<td></td>
<td>• Inability to Act Quickly</td>
</tr>
<tr>
<td>Increased Levels of Automation</td>
<td>• Operators Become Disengaged</td>
</tr>
<tr>
<td></td>
<td>• Role Is Reduced To Dealing With Upsets</td>
</tr>
<tr>
<td>Centralized Operations</td>
<td>• Loss of direct awareness</td>
</tr>
<tr>
<td>Staffing Issues</td>
<td>• Operators Lack Experience</td>
</tr>
</tbody>
</table>
Situational Awareness

The perception of environmental elements with respect to time and/or space, the comprehension of their meaning, and the projection of their status.
Creating the Business Case
Safe and Reliable Control

Poorly performing alarm systems AND HMI are contributing factors to major accidents and poor operating performance.

Proper Alarm System Management and Alarm System Performance is essential to maximum-efficiency operations.

There are multiple contributing factors:

- Alarm Management
- Human Machine Interface
- Control Loop Performance
Measurable Costs/Value

Raw Materials → Process → Products/Services

Energy → Waste

Aspects of Good HMI Design Philosophy

- Goal Oriented Design
- Hierarchical Information Organization
- Proper Color Usage
- Actionable Alarm Awareness
- Effective Design Elements
Goal Oriented Design

Common Mistake – The System is the Goal.

1.0 Major goal

1.1 Sub-goal
- Decision
  - SA requirements:
    - Level 3: Projection
    - Level 2: Comprehension
    - Level 1: Perception

1.2 Sub-goal
- Decision
  - SA requirements:
    - Level 3: Projection
    - Level 2: Comprehension
    - Level 1: Perception

1.3 Sub-goal
- Decision
  - SA requirements:
    - Level 3: Projection
    - Level 2: Comprehension
    - Level 1: Perception

Goal Directed Task Analysis
Information Organization

Common Mistake: Organize by P&ID

Sheet 1  Sheet 2  Sheet 3  ...  Sheet N
Display structure

Level 1 – Area-wide overviews
  - KPIs, summary status information

Level 2 – Facility-wide overviews
  - Key operating screens, specialty pages

Level 3 – Detailed operating information
  - Similar to most current screens

Level 4 – Auxiliary information
  - Help screens, trend pages, etc.
Reduced Navigation

Task Orientated Level Two Displays
- To startup operator had to visit 12 screens.
- Operational level 1 screen to start up a Boiler
Proper Color Usage

Common Mistakes:
Color and Attention

Color is a powerful way to guide attention

- Your eye is automatically drawn to colored objects
  - This is called the “pop out” effect

- Flow the this ‘d’s and “l”s in this picture...

Source: NASA Ames Research Center Color Usage Lab
http://colorusage.arc.nasa.gov/popout.php
Color and Attention

APGs take advantage of the “pop out” effect to guide operators’ attention to values that are in alarm.
Color and Attention

BUT – if you use too much color, the “pop out” effect doesn’t work anymore

Click and then try to find the “I”s in the picture...
Different tastes...

Reactor 1
- Run Plan: Actual:
- Prod: Thionite
- State: Mid-Run
- Agit: ON
- LVL: CLEAR
- Balance IN OUT
- Rate 80.0
- Rate 72.0
- 2 HR

Reactor 2
- Run Plan: Actual:
- Prod: CRM-114
- State: Mid-Run
- Agit: ON
- LVL: CLEAR
- Balance IN OUT
- Rate 68.0
- Rate 60.0
- 2 HR

Hydrog A
- Cycle Comp A
- Bed A1
- Bed A2
- Suct Dsch
- VIB: OK
- BRG: OK
- OIL: OK
- Locks: CLEAR
- 500 FLOW
- 470
- 2 HR

Hydrog B
- Cycle Comp B
- Bed B1
- Bed B2
- Suct Dsch
- VIB: OK
- BRG: OK
- OIL: OK
- Locks: CLEAR
- 500 FLOW
- 470
- 2 HR

Key Performance Indicators
- Conversion Efficiency
- 80%
- 70%
- 60%
- 2 HR

Emissions Limit Ratio
- 1.0
- 0.5
- 12 HR

Feed System
- Feed A
- Feed B
- Feed C
- SynG
- CWT
- CWP
- S10
- S200

Aux Systems
- Atv 1
- Atv 2
- Pres
- %IP
- PWR
- VentP
- VentT
- MGA
- C57D
- Null-A
- Jup2
- Grok
Is there only one palette choice that is right?
Actionable Alarm Awareness

Common Mistakes:
Best Practices: Alarm signaling in the HMI displays

1. Severity 1 response time < 5min
2. Severity 2 response time < 30min
3. Severity 3 response time < 60min
4. Severity 4 response time < 120min
Navigation Badges

Overview
1 4 1 6

Reactor 31
1 2 1 3

Reactor 32
3

Reactor 33
2
Effective Design Elements

Common Mistakes
Wonderware Situational Awareness Library

WW HMI SCADA-04 Discover the new Situational Awareness Library in InTouch 2014

Wonderware will provide with InTouch and Wonderware System Platform:

• New types of animations (points, style, sweep angle, trends)
• And a SAL library of ArchestrA Graphics (2014) and objects (2015) to support the dvt of Highly Efficient Graphics at lowest cost
• This new version will also provide a Symbol wizard and themes management
Objects

Blower
P XXXX
A A A
50 %

Pump
PUMP

Rotary Valve
RV

Control Valve
CV XXXX

Mnemonic Control Valve
CV XXXX
A
43 %

RPM Meter
RP XXXX

70 rpm

Damper
DM XXXX

Compressor
K-101

Turbine

HV/LV Switch

Direction Arrow

Parallel Control Valve

CV XXXX A/E

49 %
12 %

3 Miscellaneous Meters with Meter Connector

Conveyor
C.001

Screw
C.001

Screen
C.001

Agitator

THE INDUSTRIAL SOFTWARE REVOLUTION BEGINS NOW
Level 3 Display
Benefits...

<table>
<thead>
<tr>
<th>Task</th>
<th>With Traditional HMI</th>
<th>With High Performance HMI</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting Abnormal Situations before alarms occur</td>
<td>10% of the time</td>
<td>48% of the time</td>
<td>A 5X increase</td>
</tr>
<tr>
<td>Success rate in handling abnormal Situation</td>
<td>70%</td>
<td>96%</td>
<td>37% over base case</td>
</tr>
<tr>
<td>Time to complete abnormal situation tasks</td>
<td>18.1 min</td>
<td>10.6 min</td>
<td>41% reduction</td>
</tr>
</tbody>
</table>
Reference Material

High Performance HMI Handbook
ASM Consortium Guidelines to Effective Operator Display Design
Designing for Situational Awareness
Information Dashboard Design
Show Me the Numbers
Take aways

• Invensys will provide a library of pre-defined objects (OOB) with next release to simplify the implementations of high performance HMIs

• Invensys will provide tools to simplify the engineering of graphics (themes, symbol wizard)

• Invensys will provide a new infrastructure for the alarm management based on Historian with embedded graphical representation

• Invensys and its Ecosystem will provide services to guide our customers in the implementation of high performance HMIs

• We are just getting started and there is much more to come...