ASM Overview

• What is the ASMC?
• The ASM Problem
  – Focus areas & mission
• ASM Consortium Guideline Areas
  – Effective Operating Practices
• Example case study showing how display design can significantly impact operator effectiveness
  – Importance of human factors in automation system design
• Summary
Founded in 1994

Creating a new paradigm for the operation of complex industrial plants, with solution concepts that improve Operations’ ability to prevent and respond to abnormal situations.

www.asmconsortium.org
ASM Consortium - History

- **1990** - Formed an Alarm Management Task Force of 25 Honeywell Customer Representatives
- **1992** - Asserted need to go beyond alarm management to improve operator support
- **1993** - Established assessment project to understand abnormal situation management with 4 of Honeywell customers
- **1994** - Generated ASM problem statement and solution requirements document
- **1994** - Founded the ASM Joint R&D Consortium - 10 companies
- **1995** - Started NIST ASM Collaborative Decision Support Program with focus on feasibility of technology
- **1998** - Established @asset.MAX product and service offerings
- **1999** - Decided to embark on 3-year short-term research to field decision support solution concepts
- **2002, 2005** - Decided to continue another 3 years emphasis on closing gaps on effective operations practices & product development
What is an Abnormal Situation?

- An industrial process is being disturbed and the automated control system can **not cope**...
- Consequently, the operations team must **intervene to supplement** the control system.
- Impacts **profitability** in multiple ways:
  - Product Quality
  - Job Satisfaction
  - Equipment Damage
  - Product Throughput
  - Personal Injury
  - Environmental Release
  - Public Relations
  - Loss of Life
  - Public Relations
The Paradox of Automation…

- Better automation leads to more sophisticated processes
- More sophisticated processes leads to more opportunities for error
- We “fix” the increasing errors with still more automation

When things go wrong, people have difficulty intervening to correct the problem!
Unexpected Events Cost 3-8% Capacity
> $10B annually in Lost Production

Source: ASM Consortium Research

Plant Operating Target
Optimization efforts
Operational Constraints

Plant Capacity Limit

Plant Incidents

Days per Year

< 60%

Daily Production Level

95%

100%

Summarized Production Data

33.5M
38.5M
24.2M

Source: ASM Consortium Research
ASM Sources of Abnormal Events

- Equipment: 40%
- People: 40%
- Process: 20%

- Often Preventable
- Mostly Preventable
- Almost Always Preventable

People:
- Fail to detect problems in reams of data
- Are required to make hasty interventions
- May be unable to make consistent responses
- May be unable to communicate well

Established in literature; confirmed by 18 plant studies - US, Canada, & Europe
ASM Effective Operations Practices
Areas of Focus

- Abnormal Situation Understanding
- Management Structure & Policy
- Training and Skill Development
- Communications
- Procedures
- Control Room and Field Environment
- Monitoring, Control and Support Applications

- Future Role of Operator Vision
- ASM Overview References
ASM Alarm Management
Areas of Focus

• Research areas include
  – Alarm Flooding Problem
  – Alarm Philosophy and Rationalization
  – Performance Metrics Development
  – Alarm Management Guidelines

• Research led to development of Alarm Management Tools
  – Maintain engineered limits
  – Alarm help for operators
  – Alarm metric reporting
  – Alert where appropriate

• Continue to support the development of a guidelines document by Engineering Equipment and Materials Users Association (EEMUA)
  – New version expected soon
  – http://www.eemua.co.uk/publications/control/

ASM® Consortium Guidelines
Effective Alarm Management Practices

Last Revision Date: 22 January 2007
Version: 5.00
Filename: ASMAlarmMgtPractices_v500.doc

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• Research areas
  – Content and Format
  – Development
  – Deployment
  – Maintenance
  – Training

• Research has led to
  – development of a product for implementing automated and mixed manual/automated procedures
  – Effective Procedural Practices guideline
Effective Operator Display Design
Areas of Focus

- Display Types
- Display Content and Task Appropriate Information
- Display Style Guidelines
- Display Layout
- Navigation
- Use of Color
- Use of Symbols and Process Connections
- Use of Text and Numbers
- Interaction with Display
- Alarm Configuration Scheme
- Audible Annunciation of Alarms
- Visual Annunciation of Alarms
- Training Program
- On-line Guidance
- Design Methodology
- Management of Change
• History
  – 1998, a paper was presented at the AIChE conference describing how an ASM member was applying the ASM Consortium's Best Practices to the design of an ethylene plant
  – In Sept, 2000 – that ethylene plant was successfully started-up and the design work was put into service
  – User interface design based on ASM principles was a key part of the implementation
    » Learnings from the NIST research put into practice at this site
  – In addition, many ASM recommended effective operating practices also in place
    » For example, extensive training on dynamic simulators in the major units prior to the plant startup

ASM Style Interface

Designed to enhance operator’s attention and perception of the plant

• Principal design aspects included:
  – Multiple windows with controlled window management
  – Multi-level views with increasing detail
  – Yoked and tabbed navigation
  – Integrated trends and alarm management
  – Integrated online access to documentation, alarm rationalization, operating procedures, logbook
  – Appropriate use of color, shape, object size, fonts, etc. based on human factors knowledge
ASM Case Study Experiment

• Question: Does an ASM style operator interface improve operator performance for identifying and resolving abnormal situations?

• Approach
  – Compare trained, experienced operator performance on their units’ own high-fidelity simulators using:
    » Traditional single window operator interface style
    » Advanced multi-window, linked navigation operator interface style
  – Ensure that the operator groups have similar experience & plant knowledge to reduce bias
  – Use results to estimate financial impact
ASM Experimental Design

• Selected 21 operators in two groups
  – 10 trained on & experienced with traditional style
  – 11 trained on & experienced with ASM

• Experiment included two main phases
  – Pretest
    » Questionnaire to assess work experience & qualifications, sample “console rounds”
    » Intent is to compare operator populations
  – Scenario performance
    » Simulator starts off in normal state, then training coordinator starts an abnormal condition scenario
    » Measure time to react/resolve
    » Defined 8 candidate scenarios, eventually used 4 of these for the comparison
Pre-Test Results

• Compared on:
  – number of years of experience as operator
  – number of years of experience in this organization
  – number of years as a panel operator
  – number of different areas qualified in
  – percentage of “console rounds” identified

• The only statistically significant difference is in the number of areas qualified – the traditional group had a small advantage

• The general conclusion is that the two groups of operators are comparable
ASM  Case Study Results

Scenario Results for differences between Interfaces

• Detection
  – On average, operators using the advanced interface detected an event before the alarm 48% of the time
  – A 38% improvement for the advanced interface over the traditional interface

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• Resolution
  – On average, operators using the advanced interface successfully handled and corrected the abnormal situation 96% of the time
  – A 26% improvement for the advanced interface over the traditional interface

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Economic impact assessment

- Conducted a Monte Carlo simulation using site abnormal event data collected on the traditional style unit
- Collected annual baseline from 6 years of incident data

The total economic impact for the unit with the Traditional Style Displays

- On average, $870K USD/year
- The median economic impact (considered most likely) was $800K USD/year
- Note that data is from a 1.8 Blb/year ethylene plant

Case study demonstrates both technical measures and financial measures, and quantifies the opportunity for improvement using an advanced interface
ASM Summary

- ASM is a difficult problem, but the potential for improved plant safety and profitability is also significant
  - ASM technology and practices improve operator performance for incident avoidance and in abnormal situations
- Some key references for further details:
- ASM Public Dashboard
  - www.asmconsortium.com