The Abnormal Situation Management Consortium: Past and Future of Abnormal Situation Management

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http://www.asmconsortium.net
We make decisions in a Hierarchy

Rasmussen’s SRK model

- Identification
- Interpretation
- Evaluation
- Procedure Selection
- Action
- Skills
- Rules
- Knowledge

Increasing Cognitive Load

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DEFINITION:
An industrial process is being disturbed and the automated control system cannot cope.

Consequently, the operations team must intervene to supplement the control system.

An Abnormal Situation Impacts Profitability – at the least
When we started in 1992

Though Accidents are Rare, Impact is Significant

- Unexpected Events Cost 3-8% of Capacity
- >$10B annually lost in production*

*When we started in 1992
ASM History

- Honeywell assembled a task force of 25 customers in 1989 to address Alarm Management
- Phillips’ Petrochemical Explosion 10/23/1989 added urgency
- Discussion with US NIST led to formation of the Abnormal Situation Management Joint Research Consortium (ASM)
- US NIST Advanced Technology Development Program matched $8.5M member funds with $8.1M for a three year Research Program 1994-1996
- Since 1997 all funding has been from members. A total of approximately $40M.
- 85% Research. 15% on Communicating Results
Sources of Abnormal Events

Causes of Process Upsets

- Operating out of range: 40%
- Improper design: 20%
- Improper maintenance: 10%
- No defect found: 5%
- Improper installation: 5%
- Improper material: 2%
- Human error: 2%
- Other: 40%

Causes of Equipment Failure

- Equipment failure: 76%
- Other: 20%
- Human error: 4%

Presented by N Kosaric at 2005 Defect Elimination Conference

70%+ due to Human Performance Issues
Managing Abnormal Situations

- This model operationalizes the activity types in the operator’s supervisory control responsibilities for managing abnormal situations

Adaptation of Supervisory Control Activity models of Jens Rasmussen and David Woods - CMA.
• Effective supervisory control involves processing information at multiple levels of detail

- The display hierarchy allows an operator to move between the “big picture” to the “details” as the task or situation requires

The Display Hierarchy is a Critical Solution for ASM
Applying Human Factors and doing simple things can improve operator performance dramatically:

1. Ensure Operators aren’t overloaded
   - Rationalize your alarms
   - Make problems obvious
   - Reduce load using automation where appropriate

2. Develop Console Displays based on Human Factors
   - Make complex things simple by making it “visual”
   - Turn data into information with proper context

3. Keep procedures up to date, easy to search, easy to use
   - Address abnormal situations
   - Automate difficult, complex, or lengthy procedures

4. Improve communications
   - Start Up / Shutdown / Shift Change

5. Improve Operator Competency
   - Train operators: Be prepared

6. Provide a conducive Control Room Environment
   - Ergonomic environment promoting operator performance
• Effective ASM Alarm Management Practices
  – Tools like Alarm Configuration Manager™
  – Deal with bad-actors
  – Set priorities
  – “First out”
    Reduced alarms from 28,800/day to 288/day

• ROI
  • Reduced shutdowns (trips)
  • Effort payed back completely due to one less trip per year

Goal is 6 or less alarms per hour & No Floods *

*ASM & EEMUA
Case Study 2: Alarm Management

- Effective ASM Alarm Management Practices
  - 4000 tags rationalized
  - 35% configured alarm reduction
  - 45% average reduction in alarms for two units

- ROI
  - Improved Operator performance
  - Better decision making

- Irving Oil refinery in Saint John, New Brunswick
  - 280,000 BPD refinery
Case Study 3: Console Interface

- Effective Operator Display Design
  - 38% better event detection before alarm
  - 41% improvement in time to solve problem
  - 26% better successful completion of scenarios

- ROI
  - Savings of $800,000 per year

- NOVA Chemicals Corporation – Joffre, Alberta
  - 6 billion lbs of ethylene annually
  - 2 billion lbs of polyethylene annually
Case 3: ASM Interface Framework Study

Key Interface Elements

• Multi-level, simultaneous views of increasing detail
  • Level 1 – Console Overview
  • Level 2 – Unit Summary
  • Level 3 – Equipment detail
  • Level 4 – Group & Point detail
• Linked navigation between views with single key stroke
• Integrated Trending
• Integrated alarm management into graphics and navigation tabs
Display Coordination

- Linked Displays
  ✓ Selecting a target on an upper level display
  ✓ Automatically opens more corresponding detailed displays
- Selected tag is put in Focus
  ✓ Opens new Faceplate
  ✓ Detail Trend
Case 4: Console Interface

- Effective Design Display guidelines
  - Minimized Information displayed on HMI
  - Alarm Minimization review

- ROI
  - 95-98% uptime in first three months.

- BP Clair Off Shore Platform
  - 60,000 barrels/day
Case 5: Training

- Effective Operator Training
  - Trained with at least 5 process trips during start up.
  - Training in simulated upsets

- ROI
  - Reduced trips during start up
  - Increased Operator confidence

- Woodside Angel Oil platform
  - Remote Controlled operation.
  - Stands in ~80 m of water
• Use AI to make Early Event Detection less costly to develop.
• Use NLP to mine HAZOP information → **Safe Operating Limits tables** to provide Operators with guidance on situations they rarely see.
• Use NLP to mine equipment manuals, provide real time assistance at start-up & shutdown to improve equipment reliability.
• **AR / VR training models** (Available today. Costs are coming down)
  – for example fired heaters / furnaces / boilers
• **Improving Emergency Response**

**Making controls and interactions proactive rather than largely reactive**
Typical Emergency Response...

Leadership Wants Better Visibility
And ERT Needs More Effective Response
Dashboard Gives Visibility

And Digitized SOPs Improve Response
Virtual Reality for Training Field Operators

Easiest with new plants (3D models)
Augmented Reality

Enhanced visualization of operational data

Find faults faster

Honeywell helps your field technicians to install equipment easily, and fix problems faster with less training and documentation.

Handsfree process

data in the field

Give your field operators direct visibility into process activity to make rounds and field observations more efficient.
RealWear HMT-1

- 854×480 pixel display effectively the size of 7 inch tablet held at arms length and viewable in bright sunlight
- Hands-free voice-visual user interface
- Local speech recognition in loud industrial areas
- Hazardous environment certification
- Attaches to safety helmet
What’s on the ASM Web Sites

• Public web site (http://www.asmconsortium.net):
  – Intro to ASM Concepts
  – Archive of Incidents
  – Published presentations, webinars, journal papers, etc.

• Members Site:
  – Substantial body of knowledge: Over 1000 reports: Status, Gate Reviews, about 250 Final Reports, substantial User Member In-kind report archive
  – Search Engine
Available for purchase, See ASM Consortium web site

A Summary in Guideline Form of ASM Findings, Summarizes <10% of Research
Honeywell is building a smarter, safer, and more sustainable world

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Connected Aircraft · Connected Automobile · Connected Home · Connected Building
Connected Plant · Connected Supply Chain · Connected Worker

1 alarm per 10 minutes and No Floods