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

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We make decisions in a Hierarchy

Rasmussen’s SRK model

**Stimulus** → **Identification** → **Interpretation** → **Evaluation** → **Procedure Selection** → **Action**

- **Knowledge** from Interpretation to Evaluation
- **Rules** from Identification to Procedure Selection
- **Skills** from Stimulus to Identification
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, the impact is significant. The operational constraints are critical, and plant incidents or abnormal situations can lead to unexpected events costing 3-8% of capacity. This translates to over $10B annually lost in production.*

*When we started in 1992

Though accidents are rare, impact is significant.
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

- Human error: 40%
- Equipment failure: 20%
- Other: 40%

Causes of Equipment Failure

- Operating out of range: 76%
- Improper design: 10%
- Improper maintenance: 5%
- No defect found: 5%
- Improper installation: 2%
- Improper material: 2%

70%+ due to Human Performance Issues

Presented by N Kosaric at 2005 Defect Elimination Conference
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

Case Study 1: Alarm Overload

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

• Shell Shearwater Platform – North Sea
  – 11,600,000 m³/d of gas
  – 18,400 m³/d (110,000 BPD) of condensate

*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
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 Organization

Corporate Leadership

- VP Ops & HSE
  - VP HSE
  - Director HSE

Site Mgmt

- Site Manager HSE
  - Operations Manager

Site Team

- Emergency Response Team
  - Site ERT
    - Crisis Manager EOC Management Team
      - Communications EOC Management Team
        - Decon Team Leader Control Point Maintenance Personnel
        - Entry Team Leader Control Point Shift Maintenance Supervisors
        - Safety Control Point Health Personnel
        - Safety Control Point Safety/Utilities Personnel
        - Offsite Emergency Services (Fire, EMS)
      - Environmental EOC Management Team
        - Entry Team Control Point Hazmat Qualified or Red Hats
      - Incident Commander Control Point Shift Superintendents
        - Control Room Officer Control Room Unit Supervisors
        - Entry Team Control Room or Control Point Hazmat Qualified or Red Hats
        - Backup Team Control Room or Control Point Hazmat Qualified or Red Hats
      - Security EOC Security Personnel
        - Medical Officer Medical Office Laboratory Personnel
**Typical Emergency Response...**

**Leadership Wants Better Visibility**

**And ERT Needs More Effective Response**

- **Checklist A** - MTW-CHK-EPIP-0003A, Crisis Manager Responsibility Checklist
- **Checklist B** - MTW-CHK-EPIP-0003B, Incident Commander Responsibility Checklist
- **Checklist C** - MTW-CHK-EPIP-0003C, Communication Officer Responsibility Checklist
- **Checklist D** - MTW-CHK-EPIP-0003D, Security Officer Responsibility Checklist
- **Checklist E** - MTW-CHK-EPIP-0003E, Environmental Officer Responsibility Checklist
- **Checklist F** - MTW-CHK-EPIP-0003F, Entry Team Leader Responsibility Checklist
- **Checklist H** - MTW-CHK-EPIP-0003H, Control Room Officer Responsibility Checklist
- **Checklist I** - MTW-CHK-EPIP-0003I, Safety Officer Responsibility Checklist
- **Checklist K** - MTW-CHK-EPIP-0003K, Medical Officer Responsibility Checklist
- **Checklist L** - MTW-CHK-EPIP-0003L, Plant Emergency or Alert Security Officer Actions (YELLOW)
- **Checklist M** - MTW-CHK-EPIP-0003M, Site Area Emergency Security Officer Actions (RED)

**EMERGENCY RESPONSE PLAN**

4.0 Fires and/or Explosions
4.1 Hazardous Chemical/Vapor Release
4.2 Confined Space Rescue
4.3 Pipeline Incidents
4.4 Bomb Threats
4.5 First Aid
4.6 Fence Line Monitoring
4.7 Hazardous Materials
4.8 Decontamination
4.9 Hurricane/Severe Weather
4.10 Severe Weather Checklists
4.11 Injury/Illness Form
4.12 Injury/Illness - Incident - Release
Improving Emergency 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.

Hands-free 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

Handsfree process data in the field
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
Published Guidelines

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

THAT’S THE POWER OF CONNECTED
THAT’S THE POWER OF HONEYWELL

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