The Abnormal Situation Management Consortium: 20 year Retrospective

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http://www.asmconsortium.net
Agenda

• What is an Abnormal Situation?
• ASM History
• How big is the problem?
• What causes incidents?
• What can we do to be Proactive: How can Human Factors Help?
• What topics does the ASM research?
• How does the ASM do its research?
• How has this changed Honeywell Products and Industry Practice? And how do we know these changes work?
• Future: What are we researching now?
• 20 Year Summary and Parting thoughts: What have we learned?
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.

ASM ‘Solutions’ Focus on Prevention and Mitigation

Loss of Life
Personal Injury
Public Relations
Environmental
Equipment
Red. Production
Product Quality
Job Satisfaction

Business Impact
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 has been committed.
- 85% is spent on Research, and 15% on Communicating Results
- 2014 is our 20th Year
How Big is the Problem?

In 2009, 118 incidents led to 78 deaths and 213 injuries.

Globally Reported: Loss of Life and Personal Injury

- **Loss of Life**: 14 (Refinery) and 64 (Chemical)
- **Injury**: 29 (Refinery) and 184 (Chemical)

ASM Data from open media 2009
Abnormal Situations Cost even without Significant Events

*Unexpected Events Cost 3-8% of Capacity
At least >$10B annually lost in production*
What Causes Incidents

Established in literature; confirmed by 18 plant studies - US, Canada, & Europe

ASM Consortium Focuses on the “Human Element” in Abnormal Situation avoidance and response

40% of $10Bn = $4Bn annually in US!
Humans vs Computers

**Humans are good at:**
- Pattern Recognition
- Problem solving / troubleshooting
- New situations
- Analogies & Learning
- Mental Simulation & Imagination
- Subconscious processing

**Computers are good at:**
- Vigilance tasks
- Repetitive tasks
- Mathematics
- Fast response to defined situations
- Automated procedures
- Search and compare
- Storing large amounts of data

**Inspiration**
**Envisioning**

**Perspiration**
**Execution**

**Arrange Work So Each Is Deployed Optimally**
Many skills are hardwired from birth

- How to learn
- Observation
- Pattern Recognition
- Visual and auditory processing
- Imagination and mental simulation

Studies with human infants show that high level skills, like pattern recognition, are already present.

Humans use imagination and mental simulation at a very high level to recognize new patterns or to detect when something is wrong.

Much of human imagination and mental simulation has a strong visual component. >30% of our conscious brain is devoted to visual processing

Make Human Work Visual, Avoid Over or Under Stimulation
Human Thinking + ASM

- Be Aware of Human Limitations
- Make it Visual, Data + Context = Information
- Avoid over or under stimulation
- People differ in experience and skills
- Concentrate on transitions
- Expect the Unexpected
1. People can remember about 7 things

2. Make more important things stand out. Put unimportant things in the background.

3. More is not better. Instead, maximize information content.

4. Maintain situational awareness through hierarchical “views”

5. Specific color combinations and environmental conditions can make shift work harder.

6. Do not make the operator have to think about data. Give them things to recognize. Data + Context = Information

7. Use stimulation carefully (Colors, Sound)
Which is more effective for determining detail?

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OR

![Graph showing data progression over time](image-url)
Human Capabilities Differ

Experts vs Novices under pressure

Enable Novices to Operate Like Experts

ASM Solutions Help Close this Gap

Decision Quality

2.6
2.8
3.0
3.2

Good

Poor

Time allowed for Decision

2.25 min

6 seconds

Experts

Novices
What does the ASM Research? The ASM Research Framework

- Human reliability improvements require focus on more than technology
- We identify the problems that have to be solved and then search for solutions:
  - Culture,
  - Organization,
  - Work place,
  - Work process,
  - Technology
Available for purchase, See ASM Consortium web site

A Summary in Guideline Form of ASM Findings, Summarizes <10% of Research
How Does ASM Do Research?

• Roadmap based on 7 practice areas laid out for 3 Year Research Plan: e.g. Program Plan 2014-2016
• Proposals solicited annually from Members, Associate Member, Honeywell, and University Members
• Proposals selected by the Research Subcommittee
• Projects kicked-off, gate reviewed, final review
• Results archived on Members-only Web Site
• Research done by teams including User Members, Honeywell Labs, Universities at sites.
• Results are rigorously tested head-to-head against prior art.
How Does ASM Decide What to Publish (Examples)

• Communication Subcommittee (CSC) sends out a request for proposals annually
• Reviews proposals, selects some for publication, webinars, & conference presentations
What’s on the ASM Web Sites

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

• 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
Evolution Of Control Rooms 1900-2040

1900 - 1950

1940 - 1980

1970 - 1990

1990 - 2040

Courtesy Brad, Adams, Walker
How About Displays?

Where are the Alarms?
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
Time to Orient
• More proactive, orienting to the problem an average of 4 minutes faster

Total Completion Time
• Took significantly less time to deal with the event and as a group, were more consistent in doing so!
• An average of 10.6 minutes vs. 18.1 minutes for those using the traditional console
• 41% improvement

Huge Improvement: Closing Gap between Novices and Expert
Design Concept

- Show alarms on a time line
- Spatially separate alarm by equipment area to support identification and ranking of problems by type and severity
- Retain alarm list for detailed troubleshooting

Results

- 6% more responses to process upset conditions
- 9% fewer false positive responses to unrelated process conditions
Honeywell Product Impact

- **Display Graphics**
  - Experion HMI, Solution Pack, Advanced Solution Pack, User Interfaces for APC, Fire & Gas, etc.

- **Alarms**
  - Experion Alarming system, Alarm Tracker, User Alert, Alarm Help, Alarm Shelving, Alarm Suppression, Alarm Debounce, etc.

- **Operations**
  - Procedural Operations, OMPro, Operator Logbook and Shift Handover, Field Advisor (handheld linkage), Early Event Detection

- **Training**
  - Operator Competency Models for OTS
Honeywell Consulting Impact

- **Control Room Design / Console Design**
  - Process Design for Start-Up (PDSU)
  - Interaction Requirements Analysis (IRA)

- **Operator Effectiveness**
  - Operator Role Complexity Analysis (ORCA)
  - Operator Competency Analysis
  - Effective Operator Displays
  - Alarm Management and Rationalization
  - Procedure Evaluation and Procedural Automation
  - Field and Console Operator Coordination

- **Operations Effectiveness**
Future: What Are We Researching?

- Operator Competencies
- Improved Consoles / Larger Screens / Better Displays
- Touch, Voice Recognition
- Integration of Data Sources
- Improved Communication and Coordination between Control Room and Field operators
- Additional Tools to Manage Alarms, Guide Operators
- Change Management

Many Opportunities for Improvement
20 Years in Summary

• The ASM® Consortium:
  – Measured the impact of “Human Error” in the US Process Industry
  – Led Research in Human Factors in the Process Industry
  – Defined Proactive Measures in 7 Areas through more than $35M in Research
  – Archived over 500 Technical Reports, approximately 200-250 are final
  – Openly published three guidelines in critical areas
  – Presented webinars and dozens of technical papers in major journals
  – Invented products and coined terms (e.g. Abnormal Situation Management)
  – Directly influenced Honeywell Automation and Control Products
  – Indirectly influenced other Vendors
  – Spawned several “Human Factors” companies

• Financial & Incident Impact
  – Incident impact is not known. It is difficult to calculate what didn’t happen.
  – Known financial impact in Member companies alone is projected to exceed Research spending multiple fold. Case Studies verify impact.

Applied Human Factors to Make Better Decisions, Faster
Thanks to our Members
Thank You for Attending