Our People are our Most Important Asset

Making Money between the Safety Limits

Ian Sutton
AMEC Paragon

Mary Kay O’Connor Center. October 2009
AMEC Paragon

- Business Areas
  - Upstream
  - Alternative Energy
  - Pipelines
- Project Risk Management
  - Reliability, Availability, Maintainability (RAM)
  - Safety
  - Process Safety
  - Environmental
Globalization has left only one true path to profitability for firms operating in high-wage, developed nations: to base their competitive strategy on exceptional human capital management.

Bassi and McMurrer (2008)

- Manufacturing moving offshore
- Engineering moving offshore
- Sophisticated instruments are taking over normal operator functions
Process Safety Management

- Part of Human Capital Management
  - Employee Participation
  - Operating Procedures
  - Management of Change
- Adapt PSM to address the high-wage issue
- One focus can be on
Very Simplified Timeline

- ORC
  - Public Hearings
  - Other Standards: RMPP, NJTCPA
- Five Year Implementation Period

1992:
- 29 CFR 1910.119
- EPA RMP

1997:

2005:
- Texas City Event

2008:
- NEP
Personal Timeline

- Marketed reliability software early 1990s
  - Fault tree analysis
  - Event tree analysis
  - Markov chains
  - Monte Carlo simulations
- Published *Process Reliability and Risk Management* (1992)
- Focus on risk to do with losing money

- Everyone was swept up with the new PSM regulations
  - Operating companies
  - Engineering / consulting companies
- Most work was not new, but forced companies to close gaps:
  - P&IDs
  - Operating Procedures
  - Hazards Analyses
  - Management of Change
- Initial emphasis on compliance
- Publishing emphasis on addressing the elements (many books from CCPS)
Dramatic Improvement in Occupational Safety

![Graph showing occupational safety improvements over time](image)

*Courtesy DNV - 2008*
Offshore (Drilling and Production)

 Combined Operations Recordable and Lost Workday/DART Case Incident Rates

Participant Incident Rate


Recordable
Lost Workday

Minerals Management Service

Courtesy DNV - 2008
Process Safety Management Progress

- **Compliance**
  - Very good progress
  - NEP data: 38 refineries, average of 16 PSM findings per refinery
  - “There’s always news about safety, and some of that news will be bad”
  - Nevertheless – compliance seems to be going well

- **Process Safety Performance**
  - Progress
  - But difficult to measure
    - Lack of consistent definition: but CCPS 2009 and UK HSE
    - Understanding near misses / complexity
    - Small number of incidents
  - Early days
Process Safety Performance

... there is no clearly visible overall decline in major accident process safety events observed in either the USA or EU, although the data is noisy and some successes do exist – notably the UK Sector of the North Sea reduction in major leak events.

Pitblado 2008

Hydrocarbon Releases Topsides (Australia)

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>19</td>
</tr>
<tr>
<td>2006</td>
<td>35</td>
</tr>
<tr>
<td>2007</td>
<td>37</td>
</tr>
<tr>
<td>2008</td>
<td>27 (3 months)</td>
</tr>
</tbody>
</table>

National Offshore Petroleum Safety Authority 2008
Reliability, Availability, Maintainability (RAM): Benefits

- Increased Production
- Increased Profitability
- Increased Productivity
- Minimal Investment
- Reduced Maintenance Costs
- Reduced Inventories
- Reduced Capital Cost
- Customer Satisfaction
- Personal Recognition
- Personal Benefits
- Public Perception
Small Facilities

- Not necessarily less effective
- May not be a “special area”
Optimum Reliability

- Initially, funds expended on reliability generate greater revenue (normal investment period)
- Slope becomes less than unity: we have “enough” availability / reliability when second differential becomes negative
Reliability / Availability

Reliability is not a single number: it varies over time.
Reliability and Safety: Alignment

- Hazardous Operations
- Unsafe Process Conditions
- Safety Bypasses
- Transient Stresses
- Reduced Chance of Catastrophic Losses
Reliability and Safety: Concerns

- Increased Safety May Reduce Reliability
- Loss of Experience
- Engineering Practices
- Daily Operations
Troubleshooting: The Safety Limits

- Emergency Limit - High
  - Safe Limit - High
  - Operating Limit - High
    - Operating Limit - Low
      - Safe Limit - Low
        - Emergency Limit - Low
          - None

Troubleshooting ($€£)

Optimum Operation (239-240)

Safe Range

Operating Range
Examples of “Trouble”

- The product is contaminated but not off-spec;
- A compressor is making an unusual noise;
- Steam consumption is up 5% and no one knows why;
- There is a strange smell; or
- The bearings on a pump are having to replaced much more than usual.

It is when problems such as the above arise that an experienced operator or maintenance technician can help his or her company save large amounts of money, often at very little cost. However, he or she does so not usually do so through the use of a formal logic process; instead he often works on hunches, intuition and experience of similar events in the past. If management is to harness this important trouble-shooting capability, systems need to be in place for capturing and understanding human expertise and for analyzing qualitative information.
Probabilistic Risk Assessment (PRA)

- Can create powerful insights
- Helps identify “the important few” and the “unimportant many”
- Gets away from “I think / You think” challenges
- But:
  - Requires heavy investment
  - Specialized skills
  - Most processes fail safe, unlike pressurized water reactors
  - Lots of variability in the process industries
  - Applicability (does not identify “Black Swans”)

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TMI-2 Nuclear Power Plant Diagram
Organizations don’t have memories — only people do.

Trevor Kletz

There’s no substitute for knowing what you’re doing.
Expert Assessment: “Blink”

- The first two seconds
- Thin slicing: very small amount of information leads to accurate conclusions
- No methodology provided
- On the other hand: formal statistical analysis is increasingly available to us – detailed analysis of baseball players is better than hunches (Supercrunchers)
Refinery Review

- Seven refineries in about three months
- Four days on each
- Team of about four people
- Not a compliance audit
- Enormous culture spread
- Systems seem to be functioning well
- “Blink” took about half a day
Management Elements Assessment

- Develop thousands of assessment questions based on expert judgment
- Not an audit
  - Audits are prescriptive
  - Audits are qualitative
  - Audits are inherently adversarial
- Each question is "obvious"
- Develop a baseline, trendline and outliers
- Can use process safety elements
- Checklist question supported by discursive information
- Two major categories
  - Process risk management (the 20 elements)
  - Asset Integrity – separate topic
## Operational Integrity

<table>
<thead>
<tr>
<th>Questions</th>
<th>Score</th>
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<tbody>
<tr>
<td>1. Culture</td>
<td>57</td>
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<tr>
<td>2. Compliance</td>
<td>76</td>
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<tr>
<td>3. Competence</td>
<td>71</td>
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<tr>
<td>4. Involvement</td>
<td>40</td>
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<td>5. Stakeholder Outreach</td>
<td>67</td>
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<tr>
<td>6. Knowledge Management</td>
<td>71</td>
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<tr>
<td>7. Hazards Identification</td>
<td>58</td>
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<td>8. Procedures</td>
<td>70</td>
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<td>9. Safe Work Practices</td>
<td>71</td>
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<tr>
<td>10. Asset Integrity / Reliability</td>
<td>52</td>
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<tr>
<td>11. Contractor Management</td>
<td>70</td>
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<td>12. Training</td>
<td>58</td>
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<tr>
<td>13. Management of Change</td>
<td>43</td>
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<tr>
<td>14. Operational Readiness</td>
<td>66</td>
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<tr>
<td>15. Conduct of Operations</td>
<td>65</td>
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<td>16. Emergency Management</td>
<td>68</td>
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<tr>
<td>17. Incident Investigation</td>
<td>60</td>
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<tr>
<td>18. Measurement</td>
<td>75</td>
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<tr>
<td>19. Audits</td>
<td>50</td>
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<tr>
<td>20. Management</td>
<td>41</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>61</td>
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**Overall Rank:** Acceptable
Totally Unpredictable Events

The World Trade Center is not the place where our intelligence agencies failed. It is the place where our imaginations failed.

Thomas Friedman. September 25, 2001

... there are known knowns; ... We also know there are known unknowns; ... But there are also unknown unknowns — the ones we don't know we don't know.

Donald Rumsfeld
“Black Swan” Thinking

- Analytical systems to encourage this type of thinking
- Experienced personnel may have seen it before
- PHAs
  - Team Meetings
  - Difficult to get a team to discuss multiple contingencies
  - Yet major events probably involve many simultaneous events
Conclusions

- Collection and organization of expert knowledge is expensive and time-consuming
- Results may not be obvious
- But it will help address the “high-wage” problem

Managers are fond of the maxim “Employees are our most important asset.” Yet beneath the rhetoric, too many executives still regard — and manage — employees as costs. That’s dangerous because, for many companies, people are the only source of long-term competitive advantage.