Bridging the Gap in Risk Management

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Sr Safety and Process Hazard Management Specialist
3M Asia Pacific Region
Sharing of “Getting Better” Experience...

- Corporate Identity
- Background: Risk Management
- 3M Risk Assessment Process for Reducing Severe Incidents and Fatalities
- Questions and Answers

3M Journey from Prescriptive Obligation to Systems-Based to Strengthening of Controls
What company do I represent?...

3M is a global company with local presence throughout the world.

3M Manufacturing and Supply Chain “True North”

Delivering the highest quality, shortest lead times to our customers, on time, in full, every time.

Operating the safest and most sustainable supply chains in our communities, which provide the most efficient operations for our shareholders.

3M is the Innovation Company that makes progress possible

- Create transformational products and solutions that enable customer success
Social Responsibility

Where does 3M stand in Risk Management?

226 Manufacturing Plants, 46 Warehouses, 36 R&Ds, Sales Office across 72 countries
20,000 active products
5 Business Groups – Third largest is Safety & Graphics

Well Managed Safety and Health Risks
Wherever 3M Does Business

Safe and Sustainable Management

Inherently Safe:
Equipment & processes that protect workers

Low Risk:
Processes & activities well controlled

Compliant:
Proactive & predictive controls
Background:

Risk Management and Traditional Approaches to Accident Prevention
Risk Management

Origin of Risk and Risk Assessment...Where did the idea come from?

THEN...

Thousands of years ago Athenians offered their capacity of assessing risk before making decisions.

NOW...

Concept of risk assessment and risk management at work as a scientific field is around 30-40 years old.
Risk Management and Regulations

Assumed acceptable risk by setting minimum requirements

Before RM was used as a Tool for injury prevention...

Countries used prescriptive regulations...

Drawing similar requirements from the US-OSHA, Asian countries like Singapore, Japan, Philippine came up with their own.

In 2006 Singapore decided to follow the UK-HSE model...switched from prescriptive to risk-based enforcement.
Risk Management & OHS Management Systems
OHSAS18001 and ISO31000

- **OSHAS 18001**
  - Sec 4.3.1 Planning (PDCA) includes establishment and implementation of procedures for the ongoing hazard identification, risk assessment and determination of controls.

- **ISO 31000**
  - Risk management framework that provides the policies, procedures and organizational arrangements that will embed risk management throughout the organization at all levels.

- **Purpose of RA**
  - Provide **evidence-based information** and analysis to make informed decisions on:
    - how to treat particular risks and
    - how to select between options.

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ISO 31000, MODEL
IEC: 2016/09
Risk Management in General

Concept of Risk and Risk Assessment

Risk assessment attempts to answer the following fundamental questions:

- What can happen and why (by risk identification)?
- What are the consequences?
- What is the probability of their future occurrence?
- Are there any factors that mitigate the consequence of the risk?
- Are there any factors that reduce the probability of the risk?

Identification of hazard is common sense.
Avoiding hazard is an informed choice.

RISK = Probability x Consequence

Is it safe to cross the street in HCMC?
Would you feel safer crossing Singapore roads?

Identification of hazard is common sense.
Avoiding hazard is an informed choice.
Risk Assessment Tools
Likelihood and Impact/Consequence Matrices

Which Matrix are you using?

Is it Consistent or Reliable?
3M Risk Assessment Process for Reducing Severe Incidents and Fatalities (SIF)
Standardized System for Risk Assessment and Management

Specific Tool for a Certain Hazard Exposure
Standardized System for Risk Assessment and Management: Specific Tool for a Certain Hazard Exposure

Risk Assessment & Prioritization (RAP) Tool for Managing High Hazard Activities:
- Factors of S x F x C
- Single observable activity (not imagined)
- Based on control rather than perception
- Use linear and exponential indices

RAP Tool:
- Strength of Control
- Frequency of Exposure
- Consequence Severity

Ergonomic Hazards
Health Hazards
Physical Hazards
Process Hazards

Risk Assessment and Prioritization (RAP) Tool

<table>
<thead>
<tr>
<th>Probability Of Control</th>
<th>Frequency Of Exposure</th>
<th>Consequence Of Severity</th>
<th>Risk Level Score (P x F x C)</th>
<th>ACTION STEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Effective</td>
<td>Very Rare</td>
<td>Catastrophic</td>
<td>1 X 10^6</td>
<td>Monitor/Current Risk Controls</td>
</tr>
<tr>
<td>Effective</td>
<td>1-2 per year</td>
<td>Severe</td>
<td>12-60</td>
<td>Monitor/Current Risk Controls</td>
</tr>
<tr>
<td>Average</td>
<td>3-4 per month</td>
<td>Moderate</td>
<td>3-15</td>
<td>Further Risk Reduction: Not Recommended</td>
</tr>
<tr>
<td>Somewhat Poor</td>
<td>5-8 per month</td>
<td>Minor</td>
<td>1-3</td>
<td>Further Risk Reduction: Required</td>
</tr>
<tr>
<td>Somewhat Ineffective</td>
<td>6-8 per day</td>
<td>Negligible</td>
<td>0.1-1.0</td>
<td>Further Risk Reduction: Required</td>
</tr>
<tr>
<td>Ineffective</td>
<td>Daily</td>
<td>Negligible</td>
<td>0.01-0.1</td>
<td>Further Risk Reduction: Required</td>
</tr>
<tr>
<td>Highly Ineffective</td>
<td>Repeated</td>
<td>Catastrophic</td>
<td>10^9-10^10</td>
<td>IMMEDIATE: Risk Reduction Required</td>
</tr>
<tr>
<td>Ineffective</td>
<td>Repeated</td>
<td>Catastrophic</td>
<td>10^9-10^10</td>
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3M Risk Assessment and Prioritization (RAP) Tool
Systematic Risk Reduction through Understanding of Exposure and Control…

Identify High Hazard Activities and Processes
Assess Risk Using Risk Assessment and Prioritization (RAP) Tool
Add or Strengthen Safeguards or Layers of Protection to Reduce Risk
Monitor Risk Reduction Progress

“Low-level controls are used in critical steps and workers are never expected to make a mistake.”

- Are the right controls in place?
- Are there enough controls of sufficient strength?
- Do the controls operate independently?
- How reliable are the controls?
- How prone are the controls to human error?
- How are the most important hazard controls monitored for reliability?
What makes 3M RA Different from the Typical?
Probability Determination – Based on Relevance & Suitability

Three General Approaches for estimating probability

- **HIRARC Risk Indices**: Use of relevant historical data to extrapolate likelihood of occurrence
- **FETA FMEA SWIFT**: Forecasting using predictive methods and failure metrics
- **CPM HRA**: Expert opinions that draw judgment from available information aided by statistical & human reliability analysis

*Structured What-If Technique
*Consequence Probability Matrix
Human Reliability Analysis

3M Method for Estimating Probability

Measurable and Observable Strength of Controls
Verifiable effectiveness of safeguards
Redundancy and Independency
What makes 3M RA Different from the Typical?

Probability Determination – Based on Strength, Reliability & Effectiveness

Singapore CP on WSH Risk Management

<table>
<thead>
<tr>
<th>Level</th>
<th>Likelihood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rare</td>
<td>Not expected to occur but still possible.</td>
</tr>
<tr>
<td>2</td>
<td>Remote</td>
<td>Not likely to occur under normal circumstances.</td>
</tr>
<tr>
<td>3</td>
<td>Occasional</td>
<td>Possible or known to occur.</td>
</tr>
<tr>
<td>4</td>
<td>Frequent</td>
<td>Common occurrence.</td>
</tr>
<tr>
<td>5</td>
<td>Almost Certain</td>
<td>Continual or repeating experience.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Likelihood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Catastrophic (5)</td>
<td>5 10 15 20 25</td>
</tr>
<tr>
<td>2</td>
<td>Major (4)</td>
<td>4 8 12 16 20</td>
</tr>
<tr>
<td>3</td>
<td>Moderate (3)</td>
<td>3 6 9 12 15</td>
</tr>
<tr>
<td>4</td>
<td>Minor (2)</td>
<td>2 4 6 8 10</td>
</tr>
<tr>
<td>5</td>
<td>Negligible (1)</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

3M RAP Matrix Detail

<table>
<thead>
<tr>
<th>VSHE</th>
<th>Multiple independent self-checking / fail-safe engineering controls that meet ANSI B11.19 Control Reliable or ISO 13849-1 Category 3 performance level. Highly effective non-engineering controls usually includes redundant and rigorous administrative controls that provide isolation and/or separation of activity from hazard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S - Strength Of Control</td>
<td>How strong, reliable and effective are safeguards and controls? Are safeguards and controls working as intended? Consider knowledge and observations of actual strength &amp; effectiveness.</td>
</tr>
<tr>
<td>MSTW</td>
<td>Minimum engineering control effectiveness. Some administrative controls being effectively practiced and verified by observation</td>
</tr>
<tr>
<td>MWTS</td>
<td>Engineering controls occasionally fail or are not always effective. Minimum administrative control effectiveness</td>
</tr>
<tr>
<td>WWLE</td>
<td>Engineering controls often fail or are not effective. Inadequate administrative controls or controls are not effectively practiced</td>
</tr>
<tr>
<td>VWNVE</td>
<td>Engineering controls do not exist. Administrative controls are missing or controls are rarely practiced</td>
</tr>
</tbody>
</table>
What makes 3M RA Different from the Typical?
Focus on Severe Injury and Fatality Potential

High Hazard Activity
- Identified tasks from more than 30 year record of investigated incidents

Red Flag Situations
- In unusual and non-routine work
- Where upsets occur
- In non-production activities
- During at-plant construction operations
- Where sources of high energy are present
What makes 3M RA Different from the Typical?

Why Focus on SIF?

Excerpts from the book – Human Performance and High Reliability by T. Conklin, PHD

Myths Must Go!

Fatalities and Serious Injuries

A Fatality or Serious Event is an Organizational Failure.

The operator knows everything.

A good organization, functioning near the margin’s edge, gives the appearance of functioning well.

This is important.

The things that kill workers are not the things with the highest perceived risk....

The things that kill workers seem to be the things that are the most difficult to control.

Catastrophic events don't occur because everything went wrong; they occur because just enough went wrong. There weren't enough safeguards.
What makes 3M RA Different from the Typical?

Why Focus on SIF? Excerpts from the book – 7 Insights to Safety Leadership by Thomas Krause. -Krause Bell Group

• Our mistaken interpretation of the Heinrich Pyramid that managing personal safety for less serious consequences at the bottom of the safety triangle will effectively address high severity consequences at the top
• Our collective misuse of injury data as the primary metric for driving and assessing safety performance;
• Our over emphasis on history-based probability estimates when determining "likelihood" in conducting risk assessments that relate to high gravity hazards
• Our failure to effectively argue against the mistaken belief that higher-level controls are generally cost prohibitive;
• Our incorrect assumption that most injuries are caused by unsafe acts that is fueled and reinforced by flawed incident investigations
What makes 3M RA Different from the Typical?
Post Assessment Review and Quality Check

Three stage Risk Assessment Review to Check Quality Attributes of HHA Reports

☑ Comprehensiveness of Hazard Identification
☑ Completeness in Existing Safeguard Recognition
☑ Consistency of Strength of Control
☑ Accuracy of Maximum Credible Consequence considering the Energy Level
☑ Uniformity of Severity in the Initial and Final Assessment
☑ Strength level in the Final Assessment Reflective of Improved Effectiveness
☑ Risk Reduction Achieved

Validated Risk Reduction thru Confirmation of Control and Effectiveness of Safeguard

Gerry,
Here are my inputs on the quality check of the WIMS Report. Please communicate with the appropriate personnel as part of the learning and continuous improvement process.

- Selection of WIIA for the HHA is incorrect. “None” could be chosen as the described task storing/stacking of finished goods does not constitute a high hazard activity of working at height.
- Description of existing safeguard “The current practice is have a 2-3 layer stacking…” is not considered a procedure and therefore not classified as safeguard.
- Reason for selecting “Very weak and not very effective” safeguard is not justified in the reason for selection.
- Description of Frequency of Exposure does not explain why “Daily” was selected.
- Description of Probable Consequence does not explain why “Severe” was selected. “People getting hurt…” is generic and does not provide the complete details for the seriousness of injury.
- If the assessment of S, F, C is accurate, the Level V for this type of hazard is quite excessive due to wrong considerations.

Unless the task (handling of finished goods) has been completely described and the quality of information in the Reports. Please revisit the...
Summary and Conclusion

Key Take Away - Towards a Serious Injury & Fatality-Free Workplace

Doesn’t require discarding what works.

Pillars of Safety
Culture of Excellence

- Leadership
- Culture
- Risk Mgmt
- Systems & Tools

1. Ensure Infrastructure Required to Drive Continuous Improvement
2. Address Related Organizational and Human Factors
3. Ensure Adequate Control of the Hazard
4. Conduct Risk Assessment and Set Priorities for Intervention
5. Identify and Inventory Situations that are Potential Precursor to Fatalities and Serious Injuries
6. Assess Current Situation and Set the Stage for the Technical and Cultural Shift Required to Prevent Fatalities and Serious Injuries

Continuous Improvement