Practical Application of Bowtie Analysis

Enhancing Traditional PHA

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Purpose of Presentation

- Introduce bowtie methodology and its use as a risk assessment tool.
- Discuss the practical application and benefits of bowtie analysis, as observed cross-industry.
- Compare and contrast bowtie methodology, and its ‘place’ within the risk management process, with the more established HAZOP process.
Bowtie Diagram

Basic Structure

Causes

Preventive controls

Business upset

Recovery preparedness

Impacts
Bowtie Methodology

A short History…

- Exact origins of bow-tie methodology are hazy – believed to originate from ICI in the late 1970’s
- Royal Dutch/Shell Group first major company to integrate bow-ties fully into business practices
- Use of bow-ties now widely spread between companies, industries, countries and from industry to regulator, e.g.:
  - Abu Dhabi National Oil Company (ADNOC)
  - UK Health and Safety Executive
  - French Government
  - Australian State Regulator
  - Land Transport Safety Authority of New Zealand
  - International standards (e.g. ISO 17776:2000)
  - International Association of Drilling Contractors (IADC)
Typical Risk Management Process; Where do Bowties fit in?

Identify Hazards

Develop Risk Scenario

Assess Risk

Bowtie Analysis

Risk Management Process
Bowtie Diagram

An Overview…
## Practical Uses of Bowtie

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
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<tr>
<td>Communication</td>
<td>How do we engage non-risk specialists?</td>
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<td>Formal demonstration</td>
<td>Can we really demonstrate control of our risks?</td>
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<td>Specific risks</td>
<td>Are these non-routine activities/ problematic areas, and their inherent risks properly understood and controlled?</td>
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<td>Critical roles</td>
<td>Do our people know what is expected of them?</td>
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<td>Competencies</td>
<td>Are competence and control requirements aligned?</td>
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<td>Procedures</td>
<td>Are they complete and effective?</td>
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<td>Auditing</td>
<td>How can we focus audits on what really matters?</td>
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<tr>
<td>Critical systems and performance standards</td>
<td>What are they?</td>
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Bowtie and the HSE Management System

HSE / Safety Critical Equipment

HSE Critical Tasks

Operator Competencies

Training and Development

Competent people provide resilience against major risks
Total Hazard Control

In the end you must have all connections in place for effective hazard control
Benefits of Bowtie Analysis

- Goes beyond usual risk assessment ‘snapshot’ and highlights links between risk controls and management system
- Helps to ensure that risks are managed rather than just analysed
- Forces a comprehensive and structured approach to risk assessment
- Excellent for communicating risk issues to non-specialists
- Ownership – involves people, gains buy-in, practical approach
- Operations – assigns responsibility for hazard controls and links to asset integrity
- All risks – not just HSE
- Risk reduction - identifies where resources should be focussed for risk reduction, i.e. prevention or mitigation
Limitations of Bowtie Analysis

- Qualitative – does not replace QRA
- Does not replace techniques like or HAZOP or FMECA
- Depends on experience of personnel and active participation
- Ensure controls in bowtie are truly independent
- Not obvious which controls are most important
- Use as a communication tool (simple bowtie) vs complete demonstration of hazard management (detailed bowtie) – potential conflict
HAZOP vs. Bowtie

In General……

- **HAZOP** excels at performing a detailed, structured review of the operation of a process, identifying the possible causes of a deviation from the design intent, the consequences and the engineering safeguards present.

- **Bowties** are a very flexible, graphical risk analysis method, that allow for visualization of the relationship between Cause – Loss of Control – Consequence and the barriers in place to manage the sequence.
HAZOP vs. Bowtie; Key Differences

- **Graphical Representation**: Allows for a much clearer, easier to understand representation of the risks and how they are managed.

- **Flexibility**: Bowties are a very flexible method, and in addition to looking at process risks (which is generally where HAZOPs are employed), are also applied to a far wider range of risks including logistics, construction, security, etc.

- **Barrier Identification**: HAZOPs tend to concentrate on the engineered safeguards in place, whereas Bowties will consider a wider range of safeguards e.g. training & competency, external protection, inspection & maintenance, etc.

- **Internal vs. External**: HAZOPs tend to concentrate on what is happening inside the process, whereas Bowties allow for consideration of external events as well e.g. external impact, weather, human error etc.

- **Preventative vs. Mitigative**: HAZOPs end to concentrate on the preventative safeguards employed to stop a sequence from happening; Bowties allow for a more thorough consideration also of the mitigative controls.
HAZOP vs. Bowtie; Key Differences

- **Representation of Risk:** HAZOPs tend to stop with the static representation of risk. Bowties allow for a deeper interrogation of the safeguards, to ask not only what is there, but why it will still work in the future.

- **Demonstration through HSE MS:** Bowtie barriers can be hot-linked to external information e.g. operating procedures, to allow for personnel to interrogate further if required.

- **‘Live’ Risk:** Bowties can be linked to ‘live’ information from maintenance management systems e.g. SAP, to show a live picture of the risk management status indicating barrier status (on- or off-line).

None of this is intended to say the Bowties should replace HAZOP. They are complementary tools. There is nothing better than HAZOP for ensuring that process systems are designed fit for purpose. Bowties follow on from this to allow for a through life picture, applicable to all levels of personnel, that can be applied to all risks.
Questions?