

**SOUND BARRIERS MANAGEMENT IN PROCESS SAFETY: BOW-TIE APPROACH
ACCORDING TO THE FIRST OFFICIAL AICHE - CCPS GUIDELINES**

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ABSTRACT

Process safety discipline should help in answering several questions about process risks:

- “Do we understand what can go wrong?”
- “Do we know what our systems are to prevent this happening?”
- “Do we have information to assure us they are working effectively?”

A general consideration that lies in the background of each risk assessment method is that any protective barrier is fully reliable. This is what the well-known “Swiss cheese model” by J. Reason intends to explain. In that model, the layers of protections are represented like some swiss cheese slices, placed in sequence.

The holes represent their being not reliable at 100%: some holes are due to latent conditions, others to active failures. Generally, barriers are put in place to have not an overlapping of the holes; this ensures that, even if each barrier is not completely effective, the whole system is still safe. But under certain conditions, it may happen that the holes, i.e. the barriers weaknesses, overlap causing the actual transformation of hazards into an unwanted event.

According to this approach, a barrier based thinking can be effective in measuring and managing risks, regardless of the typology of them. Center for Chemical Process Safety (CCPS) of American Institute of Chemical Engineers (AIChE) translated this approach in the very well known Layers Of Protection Analysis method (LOPA) where barriers are identified as Independent Protection Layers (IPL) characterized each one by a probability of failure on demand. In recent years “barrier based management” has become a fundamental element of process risk management and barrier quality and effectiveness judgement became an important issue to deal with considering their entire lifecycle.

Barriers are the “safety measures” or “controls”. Barriers interrupt the scenario so that the threats do not result in the top event when control is lost over the hazard. Barriers can also ensure that the top event does not escalate into an actual impact (the consequences). Barriers can be categorized using any classification system desired.

A common classification system is if the functioning of the barrier is dependent on human behavior or technology. Categorizing barriers very often creates a greater understanding of how risks are managed. You can build on this basic barrier structure further to deepen your understanding of where the weaknesses are. Barrier categorizing your barriers as a certain type, it is also advised to include information on barrier effectiveness.

After that, you can look at the activities you have to implement and maintain your barriers. This essentially means mapping your management system on the barriers.



Also determining who is responsible for a barrier and assessing the criticality of a barrier are things you can do to increase your understanding of the controls that are in place for the threats posed by a specific risk. Barrier based approach is the founding principle of two specific assessment methods: Bow-Tie (BT), used for risk assessment and management, and Barrier Failure Analysis (BFA), used for near-accident, near-misses and accident or unwanted events investigation.

The BT diagram is the core of the BT method and one of the most used diagrams within barrier based management. With the bowtie diagram you can visualize a risk scenario that would be very difficult to explain otherwise. A BT is a diagram that visualizes the risk you are dealing with in just one, easy to understand the picture. The diagram is shaped like a “bow-tie”, creating a clear differentiation between proactive and reactive risk management.

The BT method was first used in the oil & gas industry (BT is referenced in ISO 17776 standard), and later in other industries such as maritime, aviation, mining, chemicals, etc. The initial application of BTs was to create a visual risk assessment, often in the context of a 'safety case' (license to operate). Article presents the work done (almost completed) by AIChE CCPS to promote a guideline for the use of BT in process safety (Project 237). Guidelines intend to review the foundation of the method, provide instructions on how to draw the BT diagram correctly and how to avoid common errors. Some specific issues are covered: typical constructs for typical process threats – corrosion, impact, improper operation / human error, operational upsets, etc. would be demonstrated. The risk management information associated with every barrier has been explained, e.g. barrier owner, performance expectation, pending actions, related documents.

The pay-off is tremendous: risk assessments come to life. Instead of being forgotten and archived, risk assessments are actually used because they are relevant in “day-to-day” operations. Furthermore the aggregation of various data sources allows a level of understanding and insight into risks, which is unprecedented in risk management until now. In particular BT becomes a significant improvement to existing LOPA assessments. It incorporates human factor and process safety management system link described in four pillars (commitment, understanding, management, learning).

