RISKworld

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In This Issue

Welcome to Issue 29 of RISKworld. If you would like printed copies please contact us, and feel free to pass on RISKworld to other people in your organisation. We would also be pleased to hear any feedback you may have on this issue or suggestions for future editions.

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Risktec in a Word

"What did you value most about the service we have provided?"
Keyword Cloud from client responses

In this edition of RISKworld we are pleased to present a number articles which we hope you will find interesting and thought-provoking.

In particular, this edition features some innovative areas that we have been developing in recent months, with the common aim of providing solutions to some of the more challenging and diverse issues faced by our clients. For example, the articles on 'Operationalising' the Safety Case and Game-Based Learning suggest ways to promote positive workforce engagement.

The articles on Land Use Planning and Fire and Gas Mapping demonstrate how technical analysis can be utilised to provide practical help in making risk-based decisions in complex situations.

Finally, the piece on Asset Integrity Management shows how the often separate disciplines of process safety and integrity management can be brought together under one roof to realise common goals.

More generally, we are pleased to report that the results from our most recent client feedback survey (carried out every six months) show that we are continuing to provide a very high level of service to our clients (see keyword cloud above). All feedback is welcomed and we are committed to following up and resolving any issues identified.

As a service provider, we are acutely aware of the need to meet or exceed the expectations of our clients and work closely and collaboratively with them. This is particularly important when an industry sector is responding to challenges (such as the current low oil price), with everyone under pressure to make effective use of limited budgets.

We continue to strive to be true to our name and provide "solutions" to our clients.

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‘Operationalising’ Your Safety Case – Engaging the Workforce

The development or revision of a health, safety, security and environment (HSSE) case inevitably involves significant time and effort, with input from a wide range of people and departments. However, once the HSSE case is delivered, the opportunity to truly embed it in day-to-day operations is often missed, leaving the workforce thinking, “How do I use it and what is expected of me?”

Ideally the workforce will have been involved during the development of the case, for example participating in hazard workshops, reviewing output, etc. This approach has the benefit of avoiding ‘paper-based’ safety, so that the case reflects what is actually happening at the facility rather than what office-based people think is happening. But in practice only a small portion of the total workforce is likely to be involved during this development stage.

The delivery of the HSSE case therefore provides the opportunity to engage with the total workforce. However, simply asking everyone to plough through reams of content is unrealistic and doomed to failure. Similarly, a handful of Powerpoint slides is unlikely to achieve any lasting effect.

The aim of ‘operationalising’ the safety case is to provide the right information to the right people in the right way. What a technician needs to be aware of, understand or work with is quite different to that of a production supervisor, which again will be different to that of an asset manager. This is the job of the ‘roll-out’ plan: to communicate the content in a clear and unambiguous way to those who need to know.

The roll-out plan

Of course, the plan can be affected by many factors including time available, budget, size of workforce, cultural and language issues, and familiarity of the workforce with HSSE concepts, not to mention corporate and business drivers. However, an effective roll-out plan will balance these issues, and look to operationalise the case in the most efficient and cost-effective manner.

The plan should be developed in close coordination with the HSSE case custodian and the training team (if required) with the overall aim of maximising awareness, understanding and knowledge of the HSSE case, targeting areas of change and improvement. There are three levels of detail, as depicted in Figure 1:

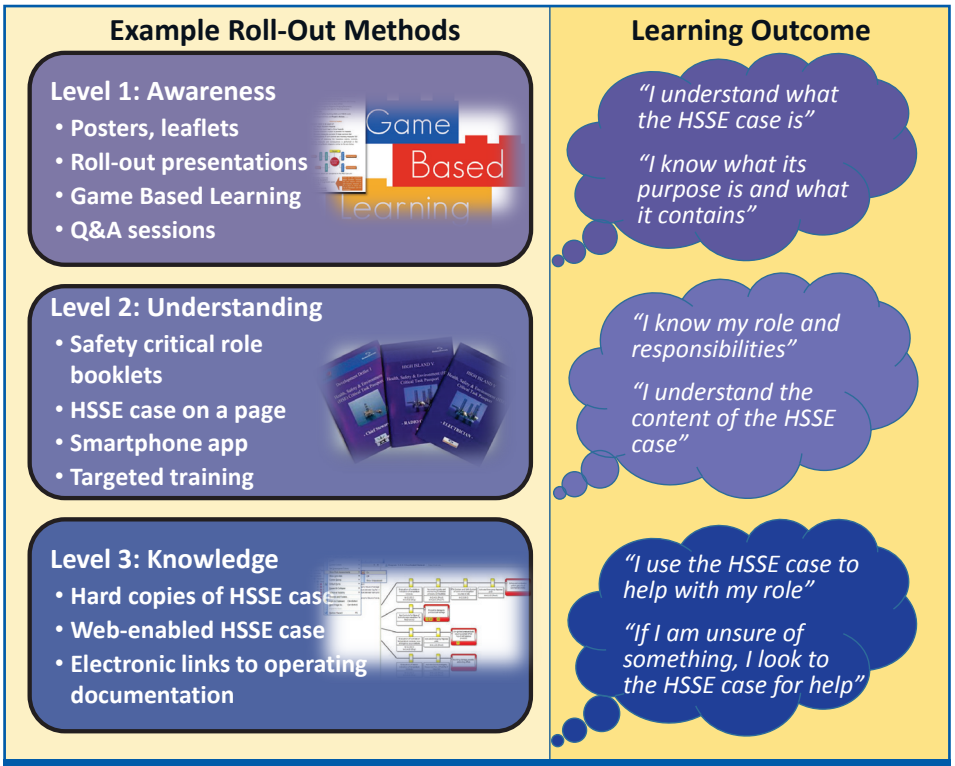

Figure 1 - Operationalising the HSSE Case

1. **Raise Awareness:** *What is the HSSE case? What does it do?*
2. **Develop Understanding:** *How do I use it? What are my roles and responsibilities?*
3. **Deepen Knowledge:** *I know when to refer to the HSSE case and why; it helps me perform my job.*

Posters, leaflets, presentations and Q&A sessions are simple and effective methods to increase awareness; safety-critical role booklets and user-friendly, targeted copies, extracts or summaries of the HSSE case are all useful tools to advance understanding.

There are also technological solutions, for the increasingly IT savvy workforce. One option is making documentation available on an intranet site, which can bring the HSSE case to life. This could range from a simple electronic file browser to a fully linked documentation suite with relevant interactive features, such as video clips, blogs, feedback opportunities, tutorials, case studies, learning from experience moments, etc. A smartphone app could even be utilised to deliver appealing content in bite-sized chunks.

At the sharp end, specific detailed changes to operating procedures (and their implications in terms of safety) may require more conventional training of affected personnel. Even here, though, there are plenty of options available, including the varied use of presentation media, role play and Game-Based Learning (see page 6).

Conclusion

A well-written HSSE case is an asset to an organisation, and provides a natural focal point for key safety, design and operations information relating to the facility. Given the development effort involved by all parties, it is worth wringing out every last benefit. Ultimately, this has the potential to transform the HSSE case into a living vehicle for safe operations.

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The House of Integrity: Modern Asset Integrity Management

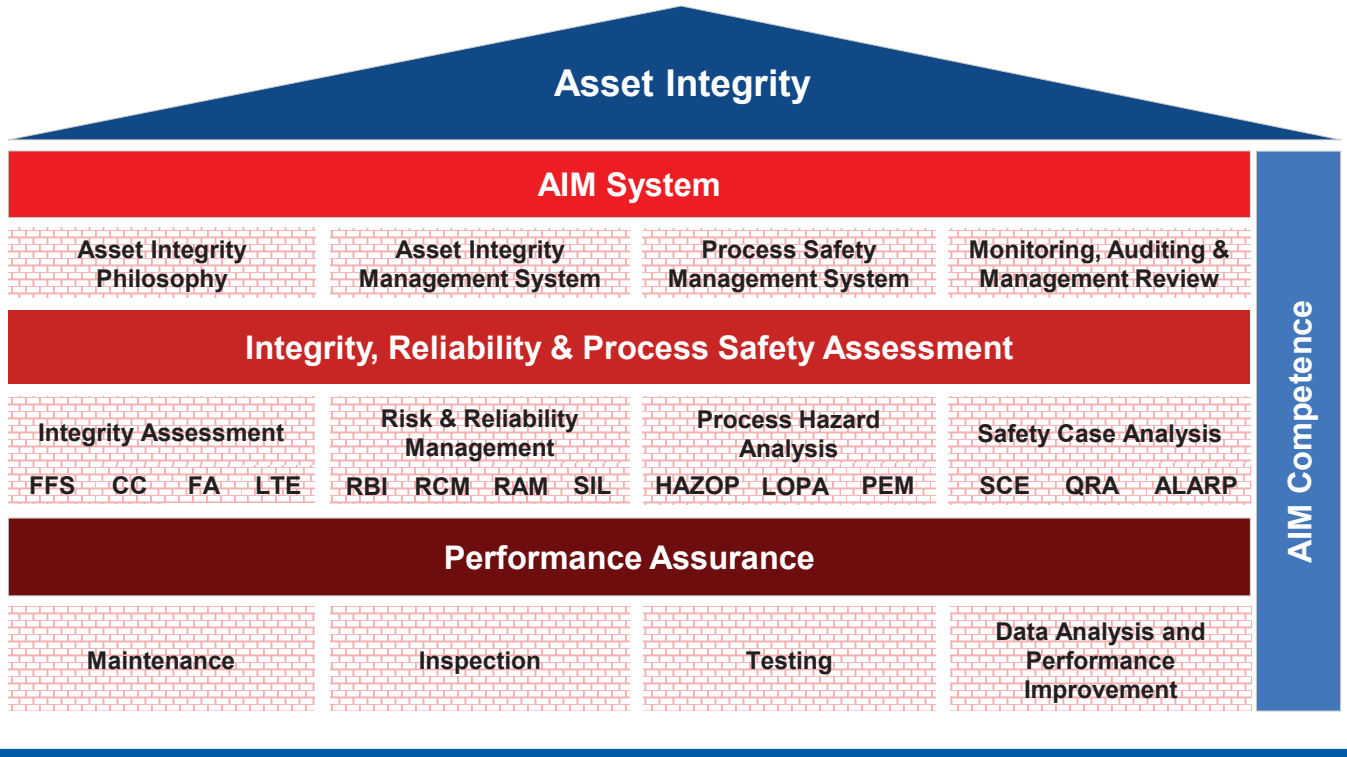

Figure 1 - The AIM House

Asset Integrity Management (AIM) is by no means a new concept or management initiative. It is a well-defined process that, if applied in the correct way, can offer asset owners and operators the ability to manage risk and assure the integrity of assets throughout their lifecycle.

The purpose of AIM is for an organisation to be able to say with confidence, based on the evidence, that "our assets are safe, reliable and efficient, and we know it."

The House of AIM

The foundation required to build a robust approach to AIM starts with using recognised international standards. PAS 55:2008, now the ISO 55000 series of standards (Ref. 1), sets out good practice requirements for managing physical assets and ensures that consistent terminology is applied. From this foundation an AIM 'house' can be built – a simplified asset integrity business model to help bring together under one roof the activities and disciplines that so often suffer from a 'silo mentality' within an organisation.

One such house is illustrated in Figure 1 and sub-divides into three floors:

1. **AIM system.** The top floor comprises the system of policies, standards, procedures and resources that are in place to deliver integrity over the whole lifecycle of the asset. There is a strong overlap with the process safety management system which aims to prevent major process incidents. The AIM system should be based on the Plan-Do-Check-Act (PDCA) continuous improvement process, with monitoring of performance, auditing of compliance and management review of continued effectiveness.

2. **Integrity, reliability and process safety assessment.** The middle floor is about conducting the relevant integrity, risk, reliability, process hazard analysis and other safety case assessments to ensure that integrity risks are understood, the asset is designed and operated to achieve its performance targets, and safety risks are as low as reasonably practicable. But beware, this is also a world filled with acronyms!

3. **Maintenance, inspection and testing.** On the ground floor, it is the maintenance, inspection and testing of structures and equipment during operations that maintain the design intent through life. Analysis of the results of these activities should be used to identify opportunities for performance improvement.

Spanning all floors is the competence of personnel in performing their tasks to the required standards.

The benefits of such a simplified model is that the different disciplines involved can each see the contribution they are making, align their processes and work to achieve a common goal. For example, some organisations have brought together their major risk and integrity management groups into one department. Another example is the use of performance standards for safety and environmentally critical equipment to provide the bridge between the claims in a safety case and the actual on-site maintenance, inspection and testing activities.

Conclusion

AIM is not just about squeezing as much life out of an asset as possible; it is about ensuring consistent performance of the asset, throughout its life, to deliver business objectives profitably and without major incident. In the House of AIM, these goals can be realised.

References

1. *ISO 55000:2014, Asset management - Overview, principles and terminology.*

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An Introduction to Land Use Planning Criteria for Pipelines

In 2012, a fireball from a gas pipeline explosion erupted across Interstate 77, Sissonville, West Virginia

In practice, the segregation of hazardous industries and populated areas is not always practicable. Urban expansion and industrial development can often lead to an increased pressure to site hazardous industries, such as refineries, chemical plants, pipeline networks, etc., adjacent to vulnerable populations like residential areas, schools, hospitals and shops.

The risk to offsite populations from major accidents arising from the release of hazardous substances can be managed through the application of criteria for Land Use Planning (LUP), which are designed to aid planning decisions.

Pipelines transporting hazardous products present unique challenges to LUP criteria compared to fixed facilities. For example, without a site security fence, they can be accidentally or deliberately damaged; it may not be immediately apparent to the operator that a release from the pipeline has occurred; and emergency response may not be available along the length of pipeline, which in extreme cases can cross international borders.

International approaches

LUP restrictions in proximity to transmission pipelines are regulated in one of three ways, depending on the jurisdiction:

1. Deterministic, e.g. USA and Canada.
2. Risk-based, e.g. Australia
3. Combined deterministic and risk-based, e.g. UK, Singapore and Netherlands.

As an example, a deterministic criterion could be a development exclusion zone of 30m either side of the pipeline, or a requirement for public consultation within a distance of 200m.

An example of a risk criterion could be restrictions on certain types of development, e.g. schools, in a zone on both sides of the pipeline where the individual risk of fatality is greater than $1x10^{-6}$ per year.

The advantages and disadvantages of the deterministic and risk-based approaches are summarised in the table below.

The deterministic approach, whilst simple and relatively easy to implement, may be overly pessimistic in nature and result in the unnecessary restriction of developments. That said, in specific circumstances the deterministic approach may be less conservative than a risk-based approach – for example, in toxic releases, where toxic clouds may extend to significant distances before they are diluted to safe exposure limits.

Rapid population growth and urbanisation may prompt the consideration of a risk-based approach since this potentially facilitates a more efficient use of land in proximity to pipelines. However, the success of risk-based approaches depends crucially on the use of appropriate data, assumptions and methods and the uncertainty inherent within key variables.

A combined deterministic and risk-based approach would appear to offer the best of both worlds: risk-based criteria tend to ensure that the solution is not overly conservative, while fixed distance exclusion zones tend to ensure a precautionary approach is taken where risk results may be uncertain.

Conclusion

Many developed countries around the world use LUP criteria to manage the location of new industrial developments and the encroachment of urban development near to existing hazardous facilities. Pipelines pose some unique challenges, not least when they bridge entire countries.

Some criteria are deterministic only, whilst others are solely risk-based. The most robust criteria tend to combine both deterministic and risk-based elements, enabling a balanced approach to safety.

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	LUP Management Approach	
	Deterministic	**Risk/Goal Based**
Pros	Provides absolute clarity of what is required of operators (and how to comply)	Performance goals allow more focus on the outcomes rather than the methods of achieving compliance
	Consistency of safeguarding reduces ambiguity and debate amongst safety professionals and regulators	Freedom to use different safeguarding solutions foster innovation and can lead to cost savings
	Specific protection perceived as desirable by the regulators and other stakeholders can be directly specified	Specific outcomes desired by the public and stakeholders can be directly required
Cons	Requirements may fail to anticipate all circumstances	Requires more analysis and documentation to verify compliance
	May not encourage innovation with respect to safeguarding	Requires a well-trained, resourced and active regulator and operator
	May limit the operator's willingness to go beyond compliance	Public and other stakeholders may not have enough trust in government and industry to ensure risk goals are met

Making the Most of Fire and Gas Detector Mapping

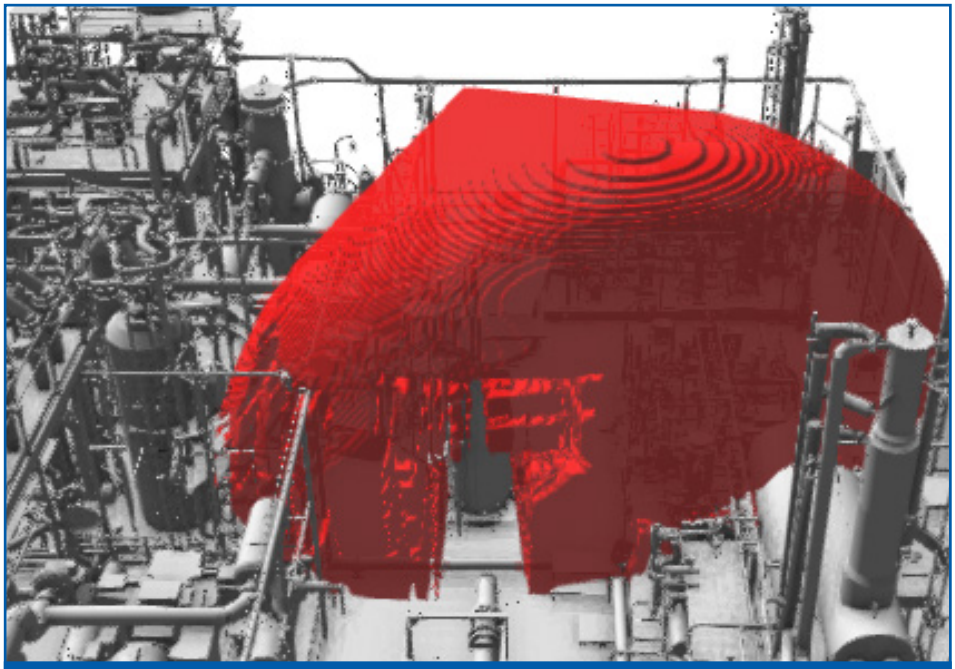
Fixed fire and gas detection systems in processing facilities typically ensure that risk mitigation systems such as isolation, blowdown and active fire protection are activated in the event of a hazardous event. A well-designed system provides an appropriate level of detector redundancy to guard against false trips and detector faults. Fire and gas detector mapping studies provide an objective analysis of detector layouts to support the design process and optimise the number of detectors needed to meet coverage targets.

Mapping or modelling?

Modelling gas detection following a leak is a difficult task, since gas dispersion depends on a large number of variables such as process conditions, hole size, release position and direction, ventilation conditions, impingement, etc. Probabilistic dispersion studies using computational fluid dynamics (CFD) can assess the likelihood of cloud formation across a process area to identify favourable detector locations. However, such analysis is time consuming and expensive, inevitably meaning that only a sample of the variables involved can be considered.

On the other hand, a mapping study avoids this degree of complexity by considering a reference cloud or fire of fixed dimension. For example, a maximum tolerable flammable cloud of 5m diameter at its lower flammable limit (LFL) is often used in offshore environments, based on research indicating the onset of damaging explosion overpressures from clouds of this size.

A map and coverage statistics are generated by considering the number of gas detectors that would alarm as the position of this cloud is moved across a detection zone, and the detector layout is tuned to ensure pre-determined spatial coverage goals are met. A similar approach is applied to fire detection, where the ability to detect a reference fire size is assessed. There is no consideration of likelihood in this approach, with the reference fire or cloud treated equally likely at each position in the detection zone.



Flame detector field of view on an offshore processing facility

Integration with other assessments

Whilst good detection coverage levels are claimed in safety cases, demonstration of adequate coverage is not normally demanded by regulators. As such, fire and gas detection mapping tends to be viewed as a stand-alone study, separate from the traditional set of fire and explosion studies supporting the safety case. There are many advantages to taking a more holistic approach, though.

Studies such as fire and explosion risk assessment (FERA) and gas dispersion assessment provide a comprehensive analysis of fire, explosion, flammable and toxic gas events across a facility, identifying what hazardous materials exist, their location, consequences, durations and potential for escalation. This can provide crucial information for mapping.

For example, detection zones can be selected based on identified toxic and flammable hazard sources; flame detector fields of view can be calibrated according to the radiant intensity of fires in each area; and dispersion distances to detection levels (high alarm set points are typically 40%-60% LFL) may be used to define the detection distance for the reference cloud. Additionally, scenarios with significant escalation potential can be identified from the FERA and extra importance placed on detection in these areas.

Detecting events clearly reduces risk and high detection probability is usually claimed in a quantitative risk assessment (QRA), yet failing to detect is often based on the reliability of detectors rather than the ability of the detection system to actually detect an event. Coverage levels from the mapping study (e.g. >2 detectors in high alarm) can be used to estimate the minimum detection probability for many scenarios considered in the QRA. This allows for a more refined evaluation of escalation frequencies and the associated risk to personnel and plant.

Conclusion

Fire and gas detector mapping is becoming more commonplace for oil and gas facilities, supported by sophisticated software tools. Ideally such studies should be undertaken in conjunction with related assessments since they can provide valuable insights into associated safety claims. In this sense, they can contribute to a more thorough understanding of the installed hazard protection and ultimately lead to improved safety through better risk-informed design.

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Game-Based Learning – A Non-Trivial Pursuit?

A common frustration within major hazard industries is that accidents continue to happen even though we go to great trouble to train our personnel to avoid them. Making learning stick is a universal problem that educational institutions have been wrestling with for decades.

But don't panic, there's an exciting solution to this problem. Game-Based Learning (GBL) takes your message out of PowerPoint and broadcasts it interactively to the trainee.

A GBL session is short and snappy, typically lasting 30-60 minutes. It is fun, it is hands-on and, by using everyday analogies for technical subjects and grounding them in the real world, it is accessible to all personnel across an organisation. By providing an appealing and immersive experience, participants acquire and retain knowledge to a much greater degree than through more traditional approaches.

This claim is supported by the research of Edgar Dale, an American educationist, who developed the concept of the 'Cone of Experience', which suggests that you remember 90% of what you 'do' when you simulate, model or experience a lesson. This is also something the Chinese philosopher Confucius understood as long ago as 500 BC when he said, "I hear and I forget. I see and I remember. I do and I understand". This is the fundamental basis of GBL.

What do GBL games look like?

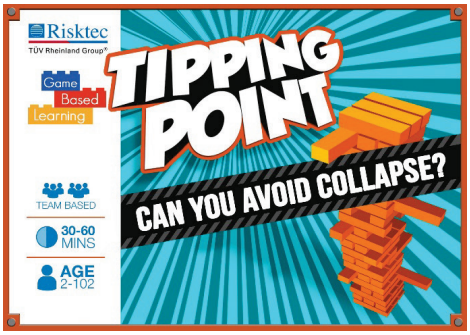
GBL can be used to get across any message in the workplace. But it's in major hazard industries – where, generally speaking, improvement is about small margins – that GBL comes into its own.

Risktec has developed a number of tried and tested games in recent years, covering common process safety themes (see examples above).

These games can be used 'off-the-shelf' or tailored to suit a specific application, operation or asset. With an idea or issue in mind, concepts, themes and analogies may be combined to develop a bespoke game which delivers the message in an effective and memorable way.

SAFETY CRITICAL ELEMENTS

This game illustrates the concept of safety critical elements in the context of an aeroplane's systems. Players use their judgement to identify those components that are key to the safety of the flight. This mirrors the identification and justification of safety critical elements essential to the prevention, control and mitigation of major accidents.



DEFENCE IN DEPTH

This game demonstrates the concept of defence in depth against major accident hazards through use of a barrier analogy. Players are given different scenarios that lead to loss of safety barriers and gain a tangible understanding of the effect on safety.

ROLES AND RESPONSIBILITIES

This game shows how essential it is to fill key roles with people with the right training, experience and expertise. Teams must complete four tasks in the correct sequence to safely ascend Mount Everest within the weather window. But there are many factors conspiring against them.

How is GBL delivered?

Like a good twister player, GBL is extremely flexible and can be delivered in a number of ways:

- Providing a diverting, energising break from a traditional classroom session.
- Using a game to deliver a serious message (e.g. a safety improvement) in a short, high impact memorable session.
- An entertaining ice-breaker within a meeting, workshop, or conference, that can also convey relevant learning.
- As part of the roll-out of a new initiative, e.g. using GBL to support the use of a new Facility Safety Case, as described on page 2.

As a result, it can be delivered cost-effectively within existing training budgets.

Conclusions

Although having fun in the workplace may still be seen as taboo by some, especially those within the serious environment of the major hazards industry, when it enhances learning, competence and safety, perhaps we all need a bit of GBL?

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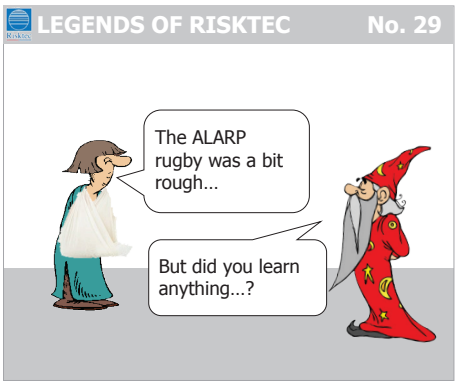

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