Beyond the safety triangle

Since Heinrich produced his safety triangle in 1931, there has been a general belief that it is possible to avoid major injuries or incidents by preventing minor ones. **Lynn Dunlop** asks if it is time for a new approach.

In an article by Andrew Hale of the Delft University of Technology[1], the author argues that while Heinrich's Triangle is still useful in some ways, the conclusion that minor and major incidents have the same causes is invalid. Hale suggests a model that takes a more pragmatic view of injury and incident prevention and concludes that understanding the various scenarios and focusing on those incidents that could lead to a genuine major disaster is the key.

It is important to clarify that although Hale uses the word 'accident', this word implies that there was no control over the circumstances and indicates that any injury to people or material was inevitable. As a true accident is very rare indeed, I refer only to incidents and injuries.

It is easy to see why the belief that reducing minor incidents can prevent major incidents has become so pervasive. There is little actual research on the topic, partly as the conclusion seems so much like common sense. The original research that Heinrich carried out was based on insurance data, and that original data is no longer available for others to study. Since then, anecdotal evidence has been so persuasive that it has seemed to 'prove' the point.

The example that Hale uses is of an object falling from a crane. The object may hit and kill, graze and injure, or miss a person standing underneath. It is rather obvious to suggest that the causes of the major incident (the object that hits and kills someone) and of the minor incident or near-miss are the same in this example. Heinrich's Triangle, however, described a ratio of minor to major incidents, not a causal link. Even Heinrich, 50 years after producing the Triangle, felt obliged to say:

"There has been much confusion about the original ratio in industrial accident prevention. It does not mean, as we have too often interpreted it to mean, that the causes of frequency are the same as the causes of severe injury … Different things cause severe injuries than the things that cause minor injuries. Statistics show that we have only been partially successful in reducing severity by attacking frequency."[2]

Causal link

The dangerous effect of the belief that there is a causal link is that some organisations have put in place well-meaning but misguided safety policies, which critically failed and led to major incidents and disasters. Organisations with excellent safety records and strong reputations have fallen victim to such disasters; Hale cites Exxon Valdez, Esso Longford and NASA's Challenger as notable examples. Another piece of research analysed Lost Time Incidents (LTIs) on chemical plants and concluded that most LTIs were a result of activities such as walking around the site, or in transport collisions. If the statistical evidence alone in these cases were used to drive safety policy, then quite naturally the emphasis at such plants would be to reduce these minor incidents. However, as Hale notes, "We are not going to get very far in preventing major chemical industry disasters by encouraging people to hold the handrail when walking down stairs."

Differentiating between incidents with a high potential for major injury or disaster to occur and those with a low potential is key in both assessing on-site safety and creating safety policy. Some workplaces, such as most office environments, have a low potential for major

injury occurrences. Other workplaces, such as chemical plants, high-speed roads, mines and oil-rigs have a much higher potential for a major injury to occur. Hale says that, "A large release of flammable chemicals will, on average, produce more fatalities than objects dropping from scaffolding. So at this level of cause there is only a very limited overlap between major and minor injuries."

Arguing that while some major incidents can "sometimes be predicted by minor accidents, but not always … and that not all

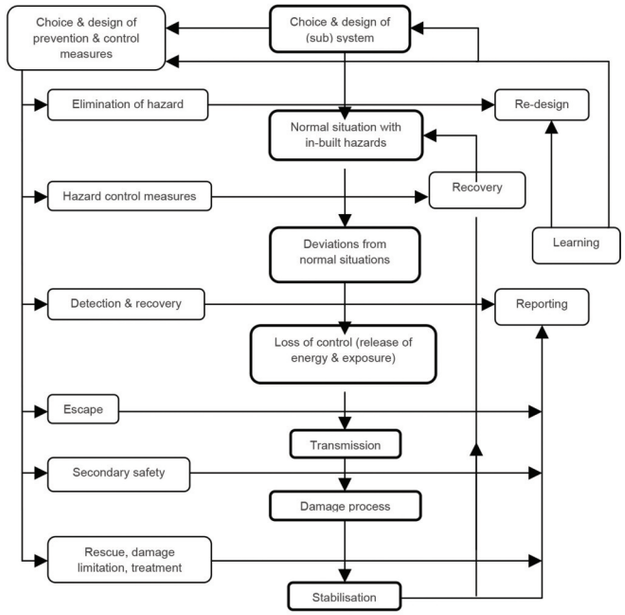

Figure 1: The Deviation Model indicates all the places in the sequence that the incident could be deviated from and prevented (Hale, 2002)

minor accidents could have been major accidents," Hale goes on to describe a 'Deviation Model' (as shown in figure 1) of an incident sequence over time. It indicates all the places in the sequence that the incident could be deviated from and prevented. He cites evidence from major incident investigations indicating there are always warning signs before a major disaster to argue that it is more often near-misses rather than minor incidents that have the potential to lead to major incidents and therefore that concentrating on minor incidents could be misleading in the quest to prevent major disasters.

By building and maintaining strong barriers that allow minor failings in a process to occur and be successfully dealt with, the system will prevent incidents. As humans are very good at spotting early indicators that something is awry and recovering from that situation, achieving accurate reports of deviations from the expected successful outcome is often difficult, especially if the incident was averted in the early stages.

Despite conventional wisdom, and with the exception of scenarios where there are few effective barriers to preventing a major injury or incident, Hale argues that this should not be a concern. Such natural filtering will allow incident-prevention efforts to be directed more keenly at those incidents, which have the greatest potential for damage. If the outcome of a near miss had a high chance of causing major injury, Hale states, the people involved will be more likely to report the incident.

Obliging people to report every minor deviation from a process is both impractical and counter-productive. If workers cannot see the value in a reporting system, they will stop using it, or use it only under duress. Only by an organisation taking action to actively address the concerns raised in every single report could this be avoided. By acting in this manner, however, it would be easy for safety practitioners to become distracted by the sheer number of reports and lose sight of the wider picture. It is important, then, to address the causes of minor incidents and the causes of major incidents as if they are related, but distinct from one another.

Due to the infrequency of incidents with potential for major injury, it is relatively rare that we get the chance to learn from the experience of making mistakes. It is therefore vital for safety practitioners to have a comprehensive map of scenarios that may lead to major incidents.

A common way of differentiating incidents with the potential for major incidents from those with minor incidents is to consider the amount of energy locked within the process. This can be achieved by considering how much energy will be released should something in the process go wrong.

It is a useful starting point for determining where incident prevention efforts may be directed, but it becomes less helpful in situations where a large number of scenarios have such a similarly high potential for releasing energy that it is impractical to assign them all with the same 'high' hazard value. In such instances, using the Deviation Model as a guide offers a more pragmatic perspective.

Key to prevention

Focusing safety efforts on processes with a potentially large energy release and where there is a greater chance that any prevention procedures may fail is, Hale suggests, the key to preventing major incidents. Where the barriers for preventing an incident are "carefully constructed… and maintained, the less chance (there is) that the accident sequence will progress to the damage stage." If we simply focus our efforts on those incidents that statistically are more likely to occur in the workplace, we will successfully reduce those incidents. But this will be at the risk of losing sight of the related, separate goal of reducing the occurrence of major incidents and injuries.

By accepting that preventing minor injuries and incidents will not necessarily lead to a drop in the instances of major incidents (as the latest research is proving) and by re-assessing the manner in which safety policies are formulated, it should be possible to reduce the number of major incidents. It is no longer justifiable to simply place the majority of injury or incident prevention systems where the majority of incidents take place.

Taking into account the potential for the incident to have been serious is vital, as is ensuring that organisations consider each of the local environments for which they are responsible on an individual basis when they are carrying out safety assessments. The construction company's office HQ will not offer the same hazards as their construction site, nor will each activity on any given site hold the same potential for damage; safety policies and practices should be structured accordingly. Andrew Hale concludes:

"We should discriminate between the scenarios that can lead to major disaster and those which can never get further than minor inconvenience. If we tackle minor injury scenarios it should be because minor injuries are painful and costly enough to prevent in their own right, not because we believe the actions might control major hazards." ■

References

References for this article can be found with the online version at: www.shponline.co.uk/features/features/full/beyond-the-safety-triangle

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