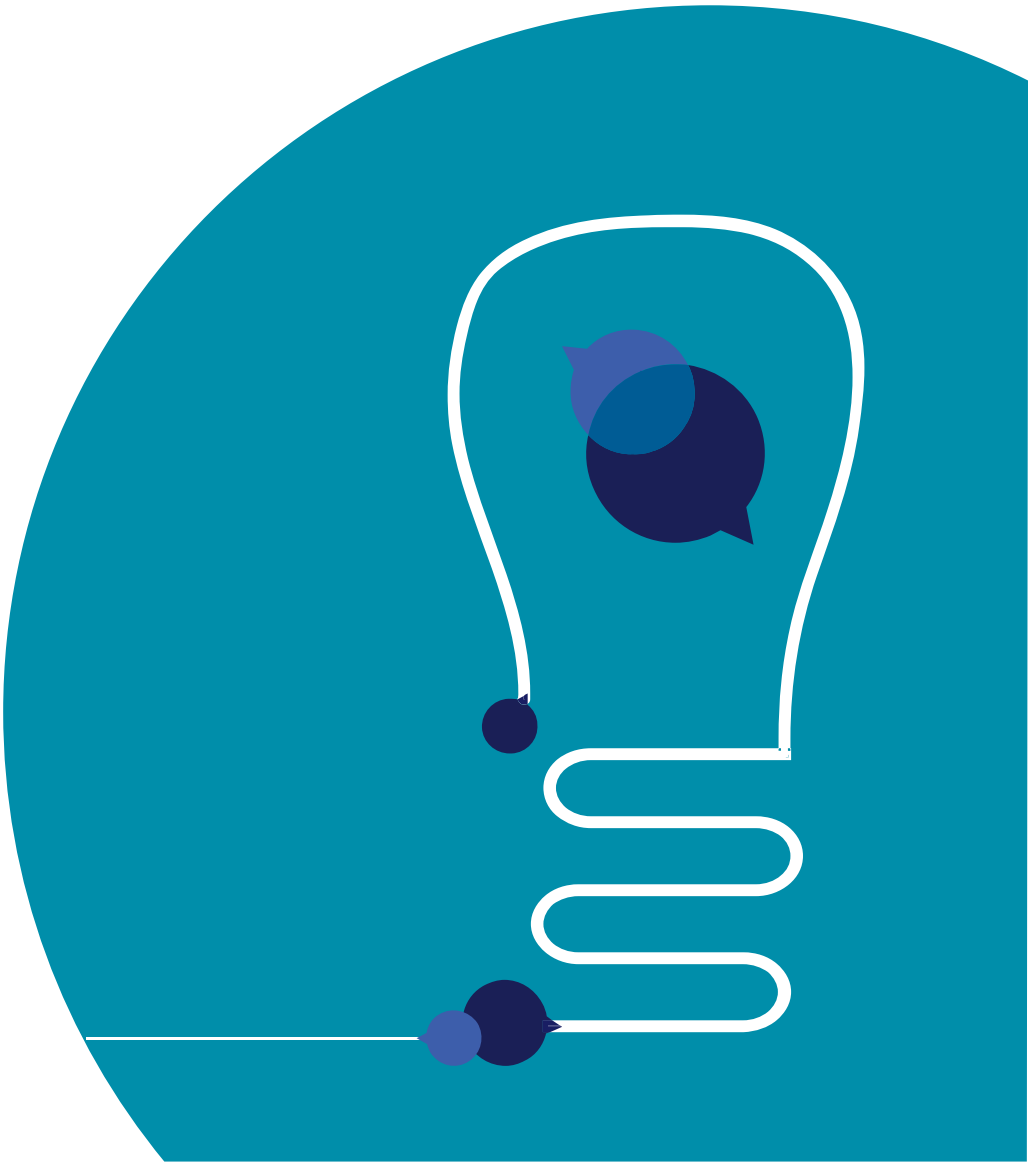
The Royal Society for the Prevention of Accidents

ROSPA

accidents don't have to happen

Little book of big ideas about health & safety



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Foreword

People seem to get ever so wound up about health and safety. In fact, they can become just as energised about what is safe or unsafe as they do about all kinds of other issues in life: religion, sex and relationships, money, social status and so on. Our modern world, in which we all live much longer and safer lives than our forebears, is nevertheless awash with unplanned events and tragedies. More than 16,000 people die annually in accidents in the UK and more than 8million are estimated to visit A&E departments as a result of accidental injuries, not to mention the 1.3million working people suffering from a work-related illness.

Safety and the avoidance of harm to ourselves and those we love is pretty fundamental . It is right at the foundation of the hierarchy of human needs – preserving ourselves and our family members . But even so, there is massive confusion about health and safety. Too often, there is unnecessary fatalism and a sense of not being able to control or, indeed, predict what will happen next.

That is why in RoSPA we say loud and clear "accidents don't have to happen!"

But at the same time, there is also a tendency to view measures designed to keep us safe as too costly or restrictive. And there is the ever-present temptation to believe that accidents will never affect us personally and so on. People's concerns about safety can embrace phobias, prejudices, irrational fears, anxieties about being blamed and sued, as well as a good old-fashioned fear of the unknown.

Safety and the need for it is actually built into everything we do – whether we realise it or not (from boiling an egg or crossing the road, to building and running a nuclear power plant) – but as with all other essentials in life, it's all about balance. Some people have a disregard for safety. Others, such as the director of NASA, see its benefits: *"Attention to safety helps to assure mission success."*

Having worked for 100 years to improve safety, RoSPA is acutely aware that the health and safety community can be accused of either making safety issues far too complicated, of being dangerously superficial or of taking some safety problems far too seriously encouraging "hypersafety", "excessive risk aversion" and the so-called "nanny state", while ignoring other safety problems altogether.

Britain's roads and workplaces are among the safest in the world. This needs to be cherished while encouraging individuals to use transferable skills to make their precious leisure time both safe and enjoyable.

Health and safety is far too important to be left to the experts (experts are there to help us – and as Winston Churchill is reported to have said, they "*should always be on tap, but never on top*"). Deciding exactly how safe things need to be and how they can be kept that way, demands everyone's involvement.

Errol Taylor, deputy chief executive, February 2017

Introduction

Health and safety is not just "common sense". Developing an understanding of risk requires knowledge and appreciation of hazards – so many of which are either invisible or behave in ways we least expect. There are, for example, noxious gases, electricity and all kinds of stored energies, invisible dusts like asbestos, dangerous micro-organisms, explosive or oxygen deficient atmospheres, the creeping effects of bad posture, noise and long latency disease.

Safety requires knowledge - which is why jungle hunters, for example, spend much time teaching initiates not only how to recognise poisonous snakes, frogs, plants and insects, but also where they are likely to be encountered, how to avoid harmful contact with them and so on.

Our modern concrete jungle, far from being inherently benign, is full of hazards about which people – above all, young people – must be taught. No-one is born with a fully developed set of instructions about how to ensure their own self-preservation or that of others. Knowledge of these things needs to be constantly developed and reinforced.

If that is so, then in an increasingly complex and challenging world, we all need to be "safety and risk literate" and to share a common safety lexicon.

This short book is a small contribution to help experts and non-experts alike to refresh their knowledge and understanding of the basic ideas which underpin discourse about safety. When, where, how , why – and to whom - do accidents happen? Indeed what do we mean by an accident? How do we use our understanding of accidents to try to prevent them? What do we mean by risk? How do we assess risks? How do we decide what is acceptably safe? Why do people disagree, and often so violently, about answers offered to these questions?

You may choose to use this book as a gateway to further reading, a handy reference guide to remind you about essential terms and concepts or as a resource in teaching. However you use it, we hope you will find it helpful.

1. Hazards, harms and safety

The world is full of **hazards** – things that can cause harm. Unless we take the right actions – consistently – exposure to hazards will always result in **accidents**.

Some people say staying **safe** is just a matter of **"common sense"**. But what is common sense?

- ***"Common sense is not so common."***
  Voltaire
- ***"Common sense is the collection of prejudices acquired by age eighteen."***
  Albert Einstein
- ***"Common sense is what tells us that the earth is flat, that the sun goes round the earth, that heavy bodies always fall faster than light bodies, that boats made of iron will sink."***
  Stuart Chase
- ***"Common sense is part of the home-made ideology of those who have been deprived of fundamental learning, of those who have been kept ignorant."***
  John Berger

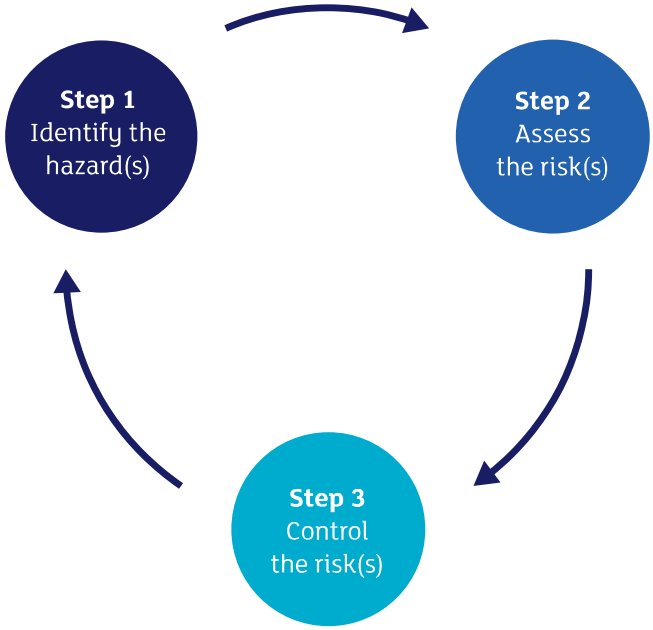
Whatever we are doing, saying **safe** requires **knowledge, understanding** and **skills** because it is all about:

- **Recognising hazards**
- **Assessing the risks they present**
- **Taking the right measures to control risks so accidents are prevented.**

Hazards are often hidden or invisible. Safety solutions can be quite counter intuitive.

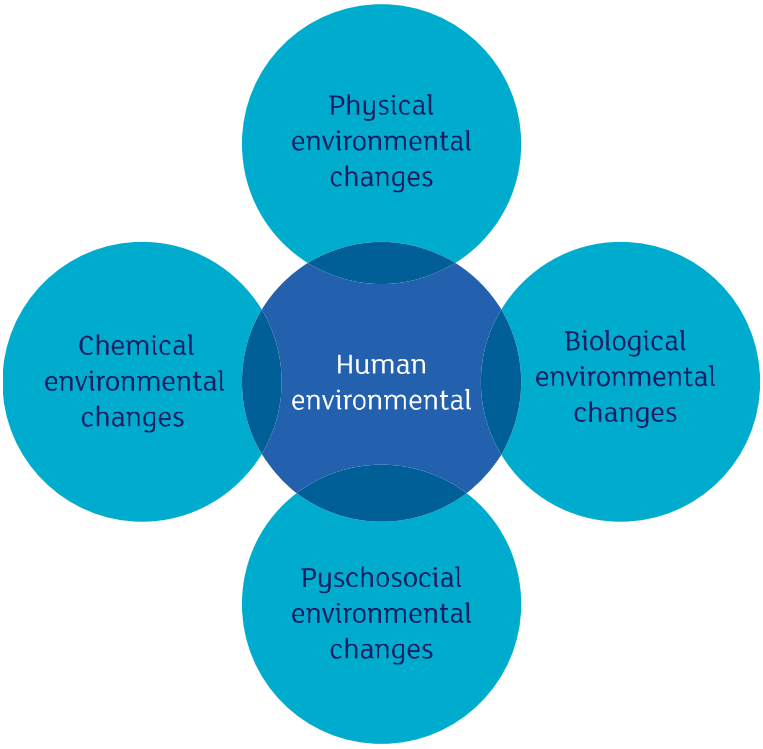
Safety is a basic human need. It should not be seen as a restraint, a burden or something that gets in the way, but an **enabler** and thus something that we try to practise every day, whatever we are doing. Whether we are at work, on the road, at home or engaged in leisure or recreational activities, taking time to be suitably safe then frees us up and gives us peace of mind so we can concentrate on other things that matter.

DIAGRAM 1: Triangulating hazard, risk and control



Hazards include: **physical things** like kinetic or stored energy, electricity, fire and so on; **chemical things** like dusts, fumes, poisonous liquids; **biological things** like micro-organisms; and even **psychosocial things** like stress.

DIAGRAM 2: Hazard types



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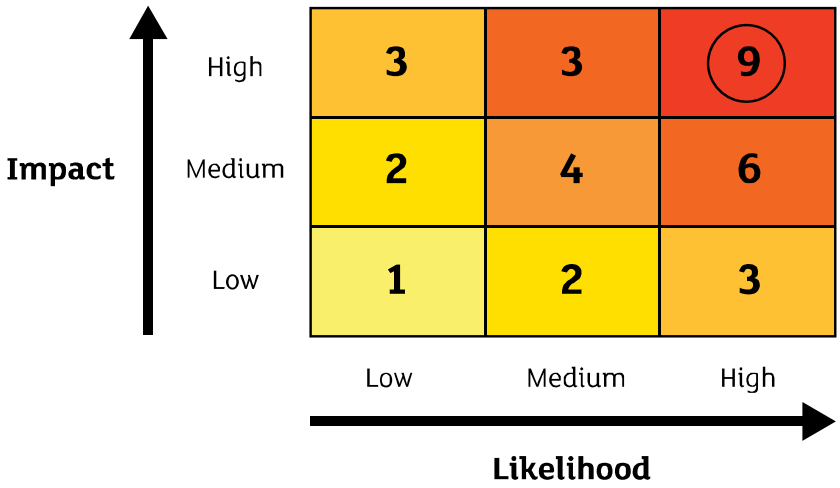
2. The idea of risk

The extent and nature of hazards and the way we interact with them result in different levels of **risk** (the level of harm x its probability). Risks can range from very severe harms that are very unlikely to quite moderate ones that are quite probable. Risk of a given harm can be expressed numerically on a scale of 1 to 9. Risks can be compared by plotting likelihood against impact.

DIAGRAM 3: Risk assessment matrix



3. Tolerable risk

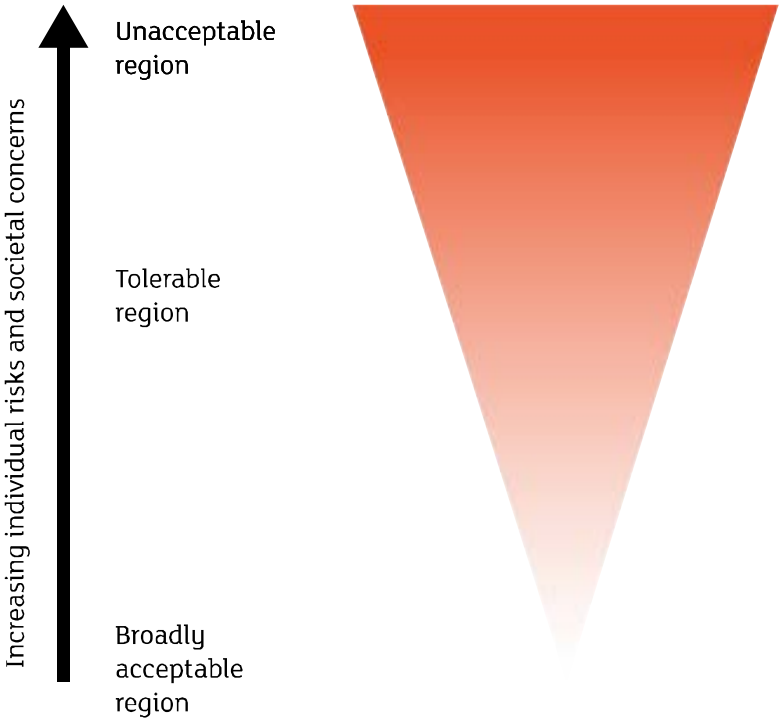
There is no such thing as absolute safety. Safety is all about making **sound choices** based on evidence so that the residual risks we choose or have to face are:

- **justified by benefits**
- **not intolerable**
- **reduced reliably to a level we are satisfied with**.

Controlling risks to our safety is an integral part of everyday life. Unless risks need to be avoided entirely, for example, because they are just too high or totally unwarranted, safety is all about choosing and applying appropriate precautions or **risk control measures** – not automatically banning things, but getting the balance right between the small amount of risk we need to be prepared to tolerate and the costs of the measures we need to take to reduce risk reliably to this level.

Tolerable risk is a useful but, nevertheless , challenging idea. It assumes that there are some risks that are so remote or so trivial that we feel that we can ignore them and they are thus broadly acceptable. At the other extreme there are risks whose consequences are so severe and whose probability is so high that they are quite unacceptable. Somewhere between these points there are levels of risks which are tolerable but which we strive nevertheless to reduce.

DIAGRAM 4:
John Rimington's risk tolerability carrot



Safety is not necessarily about reducing all risks to the trivial level but deciding when a low enough level has been reached.

In RoSPA, we sum this up by saying: "**things should only be as safe as necessary, not always as safe as possible**."

4. Risk assessment

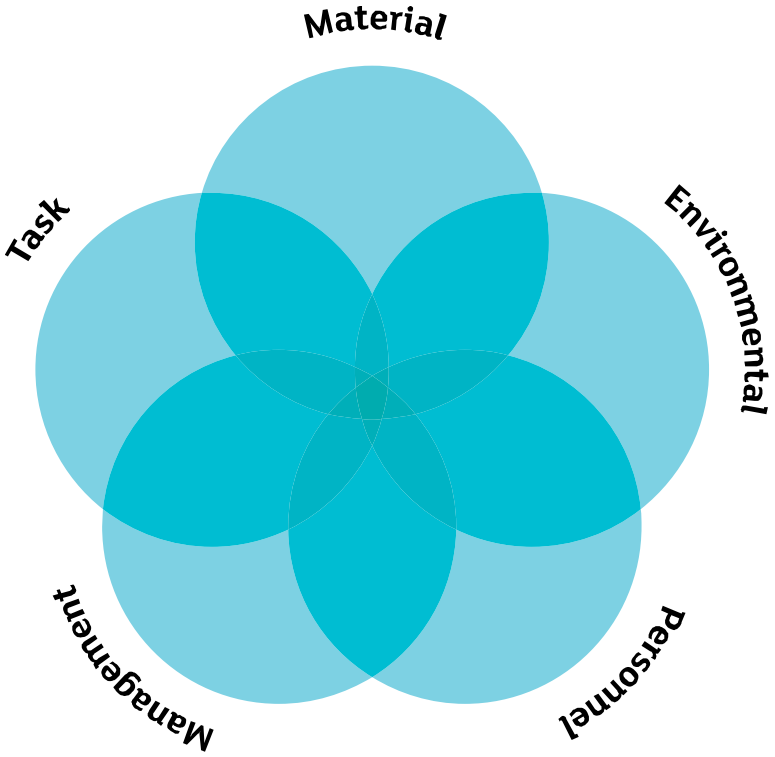
Good safety decision-making starts with suitable and sufficient **risk assessment**. Critical questions in assessing risks include not just:

- What could go wrong, when where and how?
- Who could be affected?
- How bad might it be?
- How likely is it?

Understanding risks in this way can be easy, but it can also be quite complex.

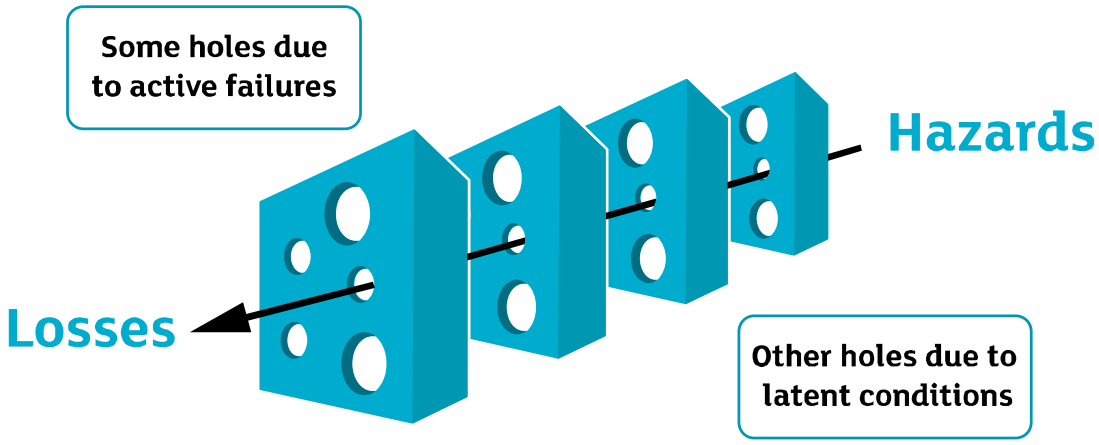
For example, various conditional factors have to interact, or line up, for an accident to happen.

DIAGRAM 5: Conditional factors, Venn diagram



Various kinds of **barrier** to safety failure can be weak, missing or break down.

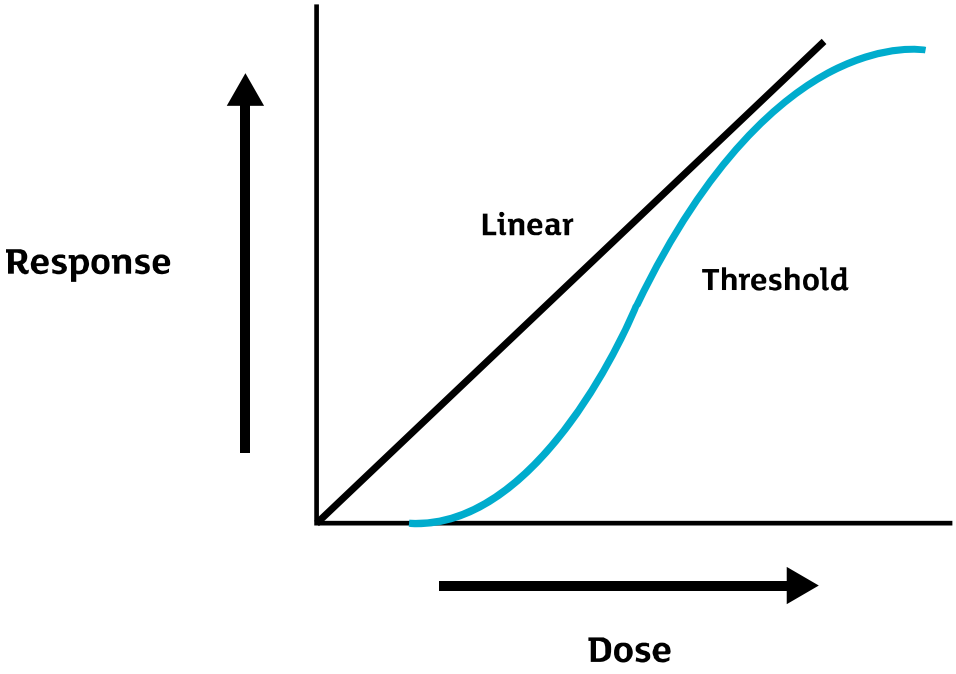
DIAGRAM 6: Prof Reason's Swiss cheese model



Successive layers of defenses, barriers, & safeguards

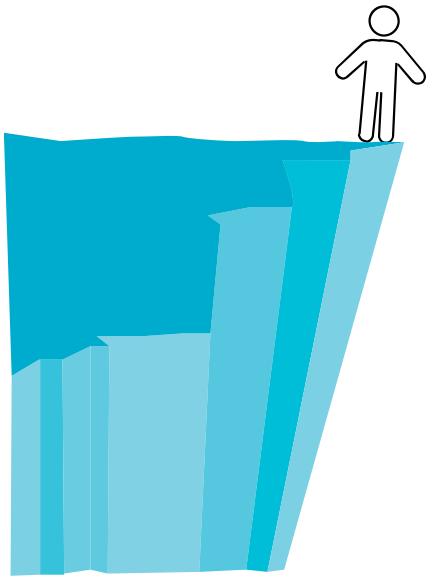
Exposure to harmful agents (such as noise, vibration, radiation, dusts or chemicals) has to be high enough/long enough for significant harm to health to occur.

DIAGRAM 7: Dose response curves



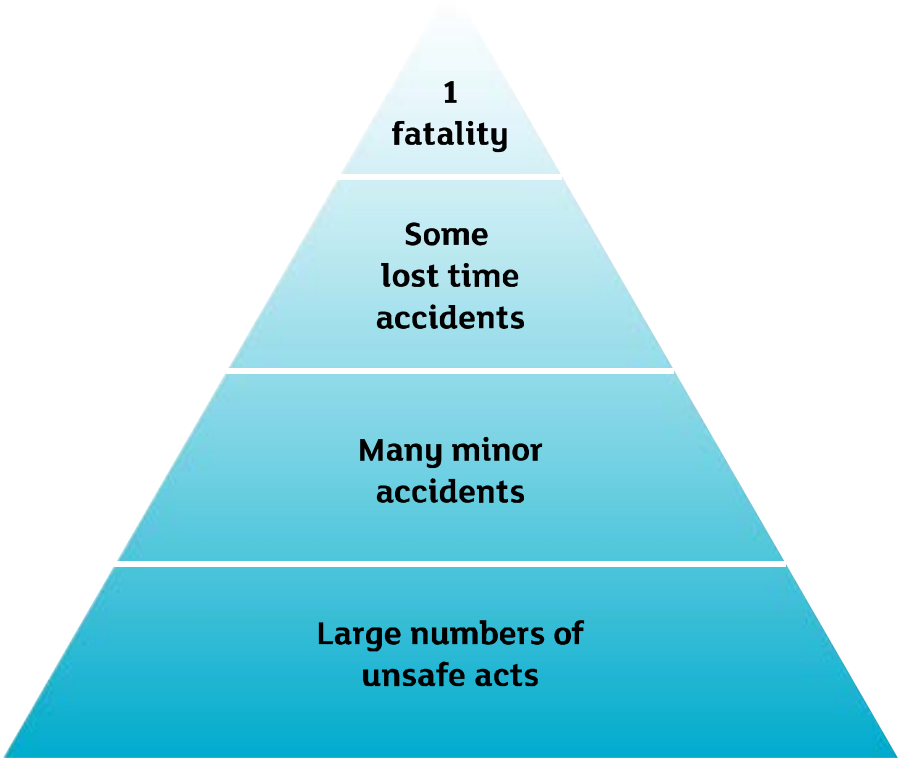
Risks can change from zero to one very quickly.

DIAGRAM 8: Cliff-edge risk



Outcomes from safety failure do not have to be the same but can vary from nothing or slight harms, to really serious. The former usually outnumber the latter.

DIAGRAM 9: Heinrich's famous triangle



In part, this is because the difference between a "near miss" and a serious injury can often be a matter of millimetres.

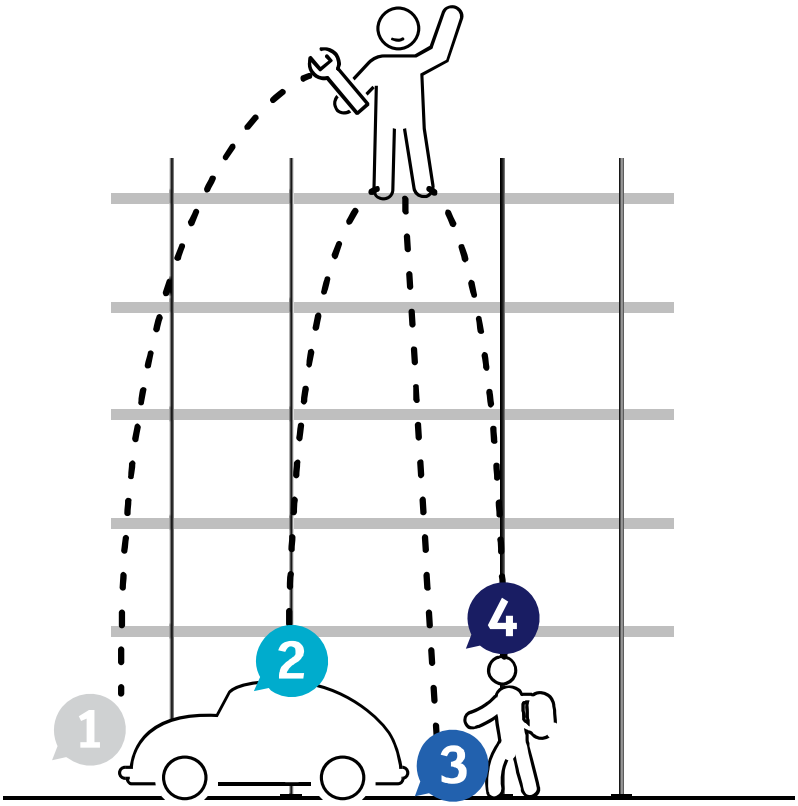
DIAGRAM 10: Outcome trajectories

1 Near miss

2 Damage

3 Minor injury

4 Fatality



Accidents, even apparently simple ones, have immediate and underlying **causes** and when investigated they often turn out to be quite complicated.

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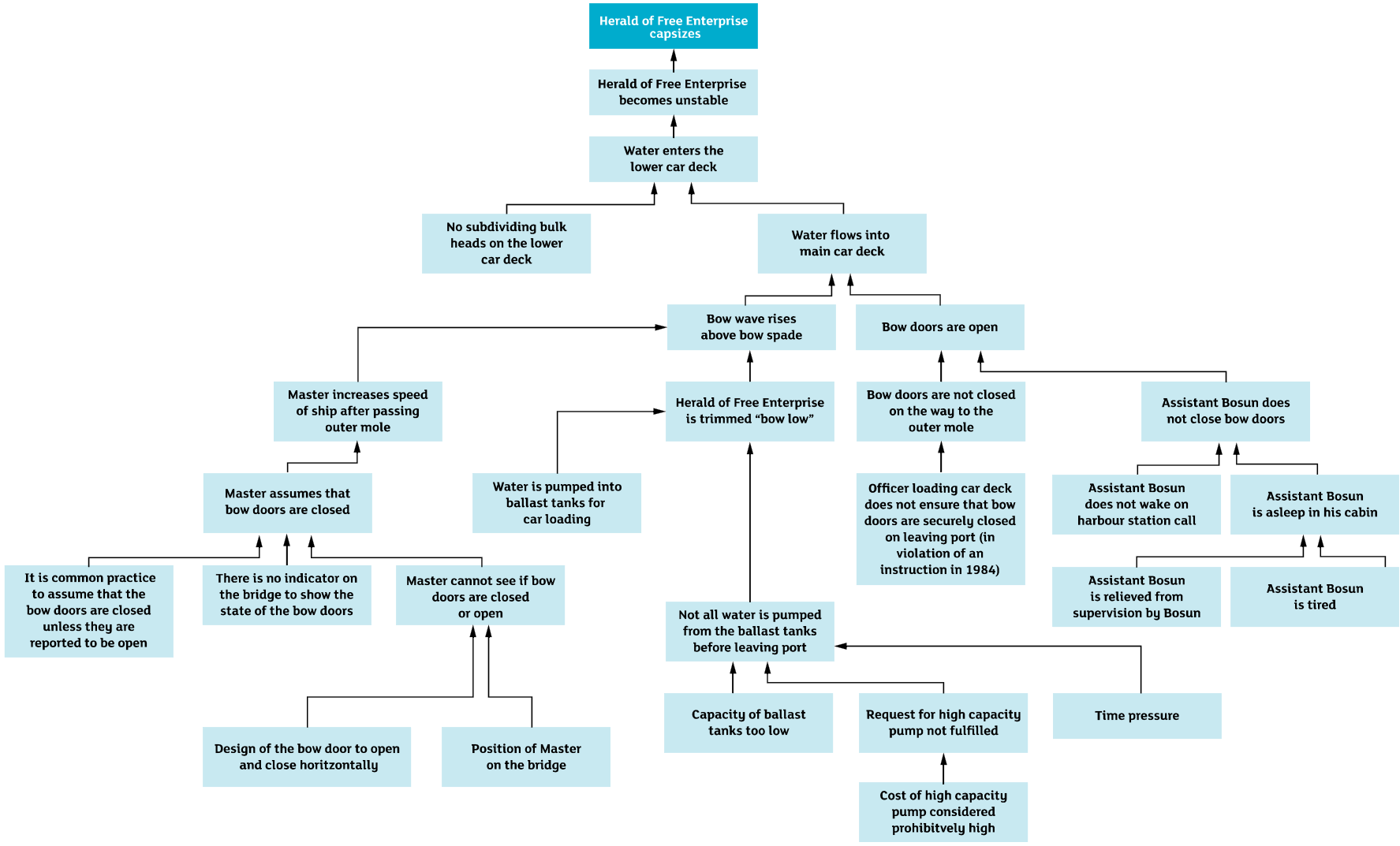
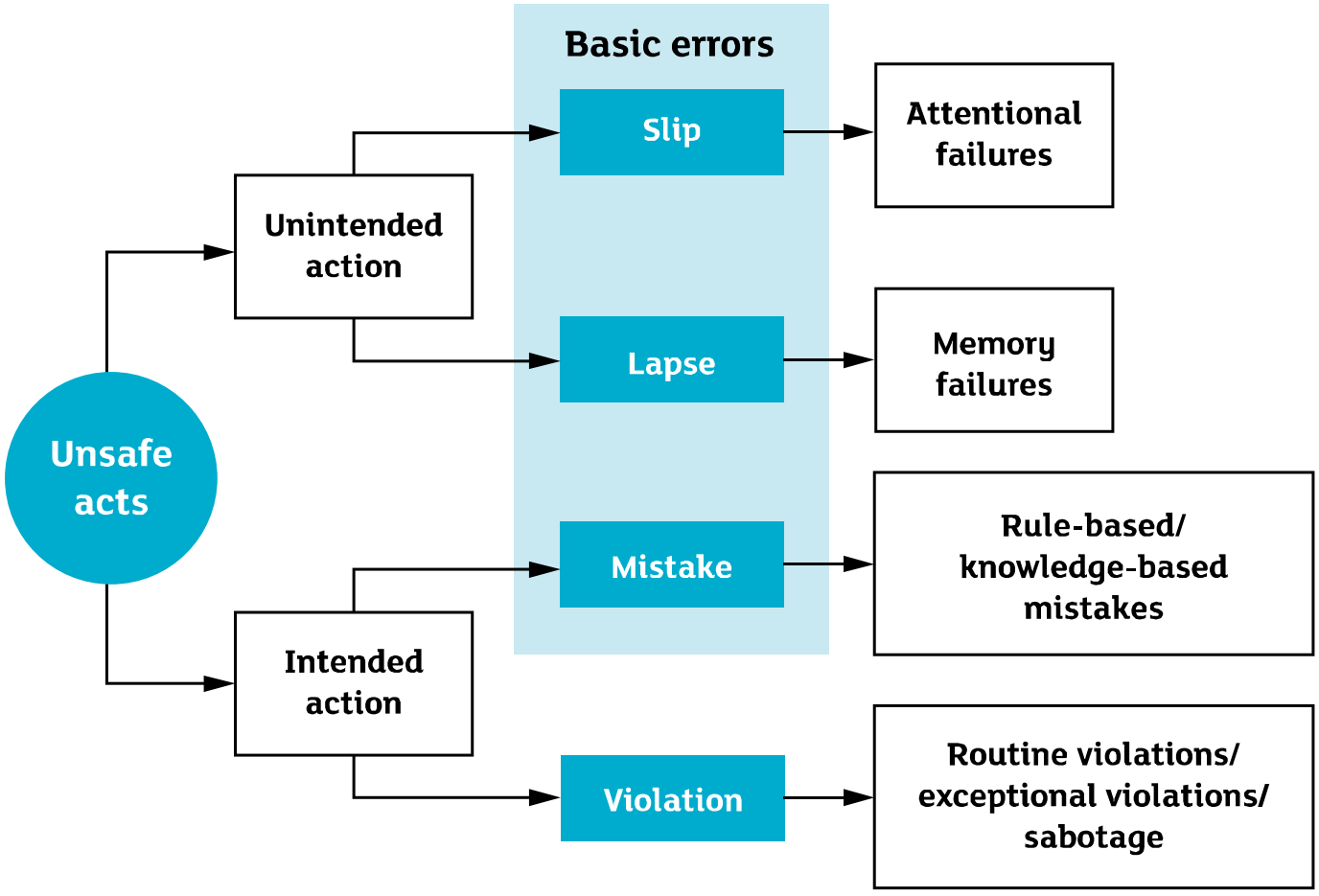
DIAGRAM 11: Accident analysis



It is often said that 95 per cent of accidents are caused by **human error**; indeed, it would be surprising if they were not. But such statements are about as useful as saying that 100 per cent of falls are caused by gravity!

Human error is a complex phenomenon, comprising: slips and lapses; mistakes (which can be skill- and/or rule-based); and violations. The latter can be "exceptional", "routine" and "situational". In turn, these forms of error can combine in various ways (e.g. error + violation = crash!). They can be exacerbated by distractions and impairments such as fatigue and ill health. And the errors of individuals can interact with other kinds of pathogenic safety weakness in organisations such as latent errors embedded in technology and systems, for example through poor design or bad communication. **Error should not to be oversimplified**. Understanding human factors, such as the way people interact with each other and with technological systems, is critical to safety.

DIAGRAM 12: Human error



All this can make determining the probability of safety failure quite complicated. Therefore, risk assessment is always a “best guess” based on modelling and from analysis of data derived from past failures.

DIAGRAM 13: Domino effect

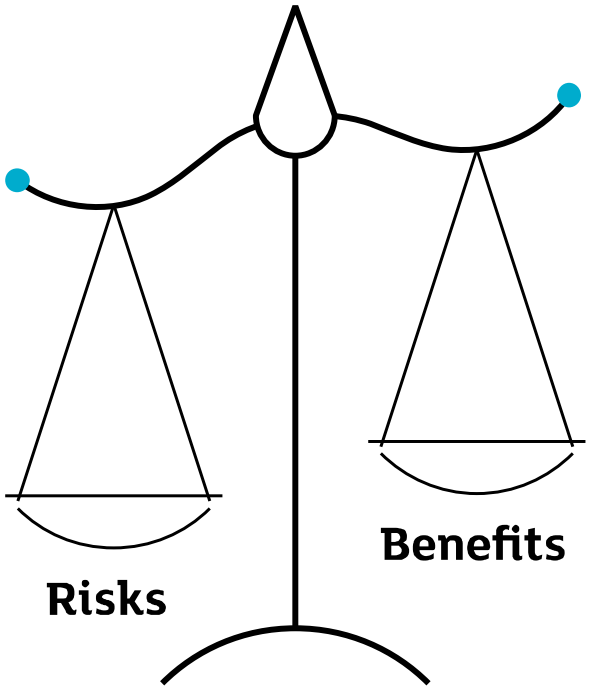
Learning from safety failure relies on gaining an understanding of the sequence of events. The first event, no matter how seemingly insignificant, sets off a chain reaction of interlinked events, the cumulative effect of which has a negative effect.

5. Safety decision-making

So how safe is **safe enough**? Too little action on safety and people will be hurt; too much and there will be opportunity costs. Time and other resources which could be better spent on ensuring other benefits, including safety elsewhere or opportunities for gain such as enjoyment or education, will be wasted.

It's all a question of **judgement** and balancing risks and costs (including the cost of forgoing benefits).

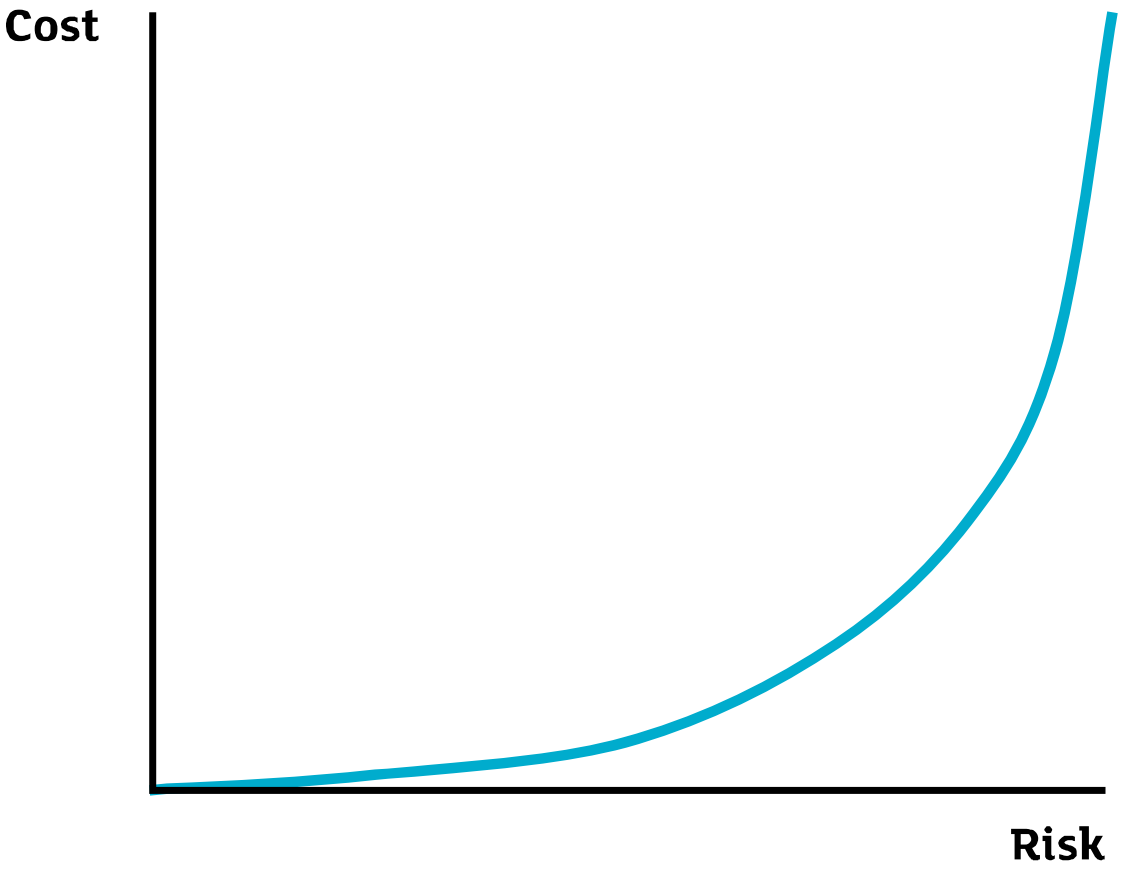
DIAGRAM 14: Risks and benefits



But it's also about taking account of **uncertainties** in the **evidence** as well as different **stakeholder perspectives**. Safety-related decision-making is not an objective science but a **societal** process. Those parties who have to bear the costs of safety measures usually insist on **evidence** of risk that is at the level of "beyond reasonable doubt". Those who might find themselves on the sharp end of safety failure tend to ask for action at the "balance of probabilities" level.

The overall aim has to be to get the widest level of agreement about the point at which there is a **gross disproportion** between the next unit of safety "spend" and the resulting increment in risk reduction – and also how far we might need to go beyond this point "for safety's sake".

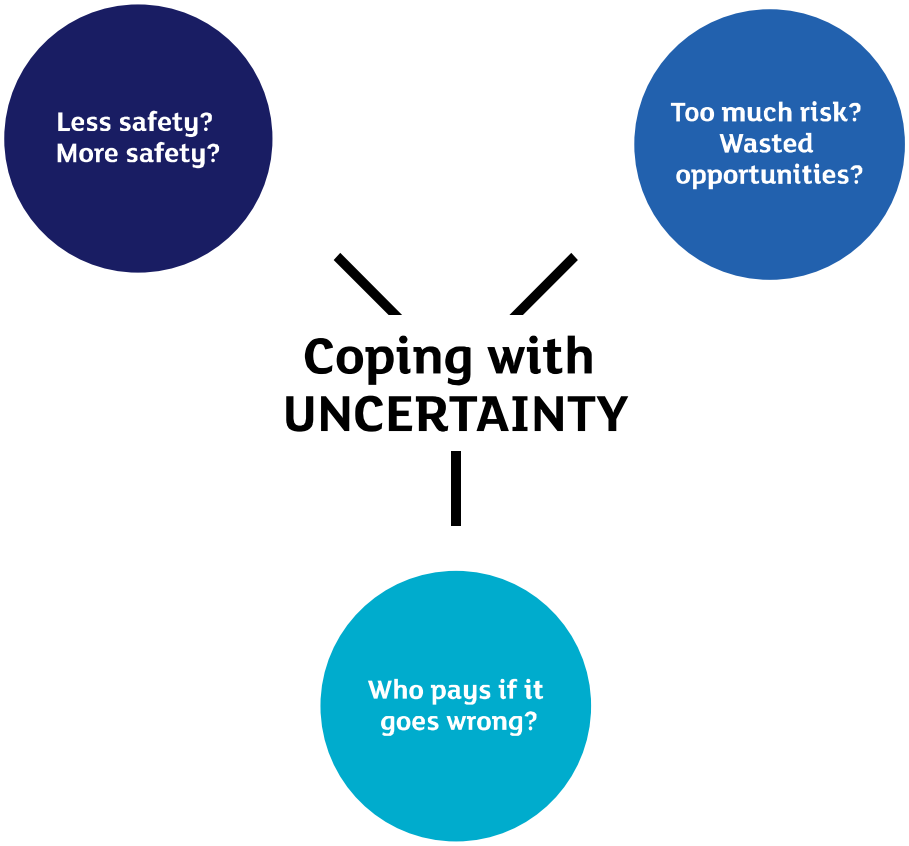
DIAGRAM 15: Risk cost optimisation curve



When there are significant uncertainties and the consequences of safety failure could be severe, decision-makers also have to have regard to the "precautionary principle". They may also have to decide on how much reliability, redundancy and/or "defence-in-depth" they need to build into their overall **safety case**. So it's not just a question of applying the "Goldilocks Principle" to find a midpoint or sweet spot that is just right (not too little, not too much). **Sound and proportionate safety decision-making is about working out just how far you need to err on the safe side.**

Remember the old engineer's adage about designing for reliability: "***If it can happen it must not matter. If it can matter it must not happen.***"

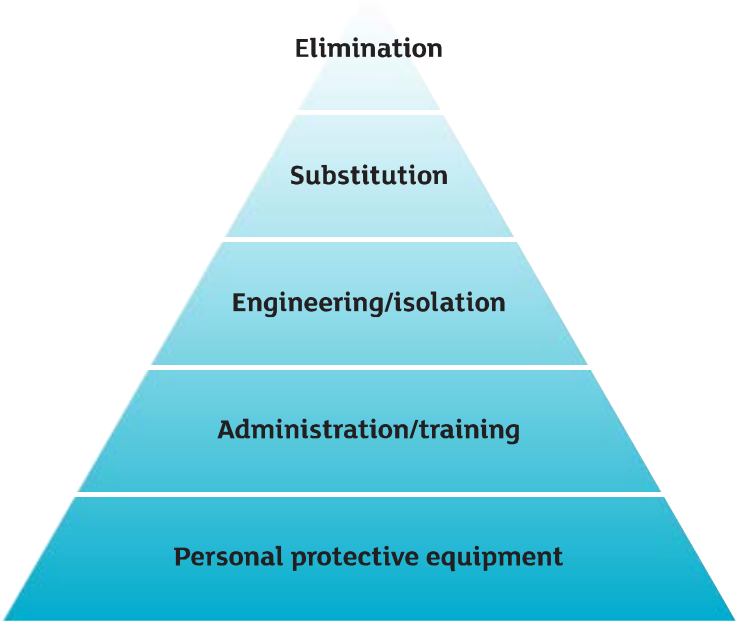
DIAGRAM 16: The precautionary principle



Another challenge in prevention is how to select the right approach to risk control from all the options in the **hierarchy of control**. Do you opt for action to eliminate or to reduce/isolate/control a hazard at source, or do you try to rely on training and discipline to enable people on the sharp end to avoid accidents, coupled perhaps with personal protection and emergency measures if things go wrong?

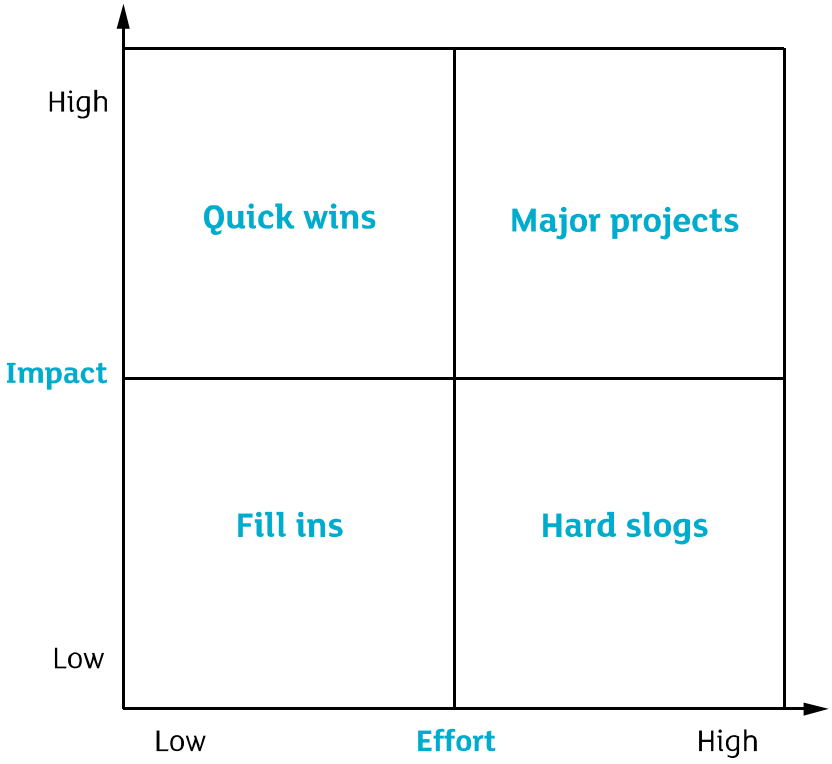
Tackling risk at source is always preferred where risks are high. And even if they are not it is still a good idea if safer alternatives are available at relatively low additional cost. Designers and planners have a big role to play in eliminating hazards at the design stage.

DIAGRAM 17: The hierarchy of risk control options



But if resources are limited, how do you select **priorities** for enhancing safety and accident prevention? Do you go for low cost but high impact action to prevent moderate but widespread harms? Or do you opt for high cost and moderate impact measures to deal with severe but infrequent ones? It can be a tough call.

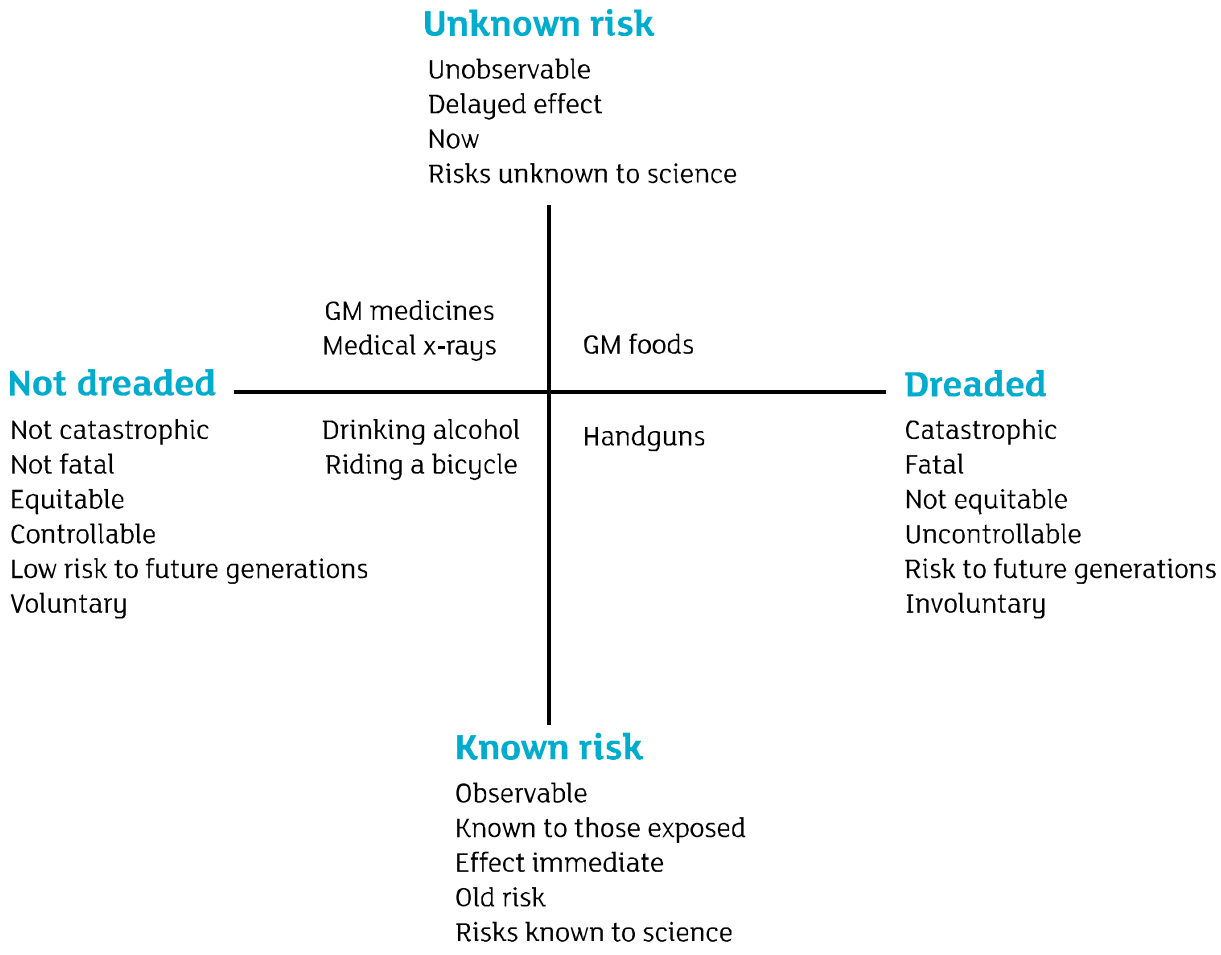
DIAGRAM 18: Low hanging fruit?



6. Risk perception

Yet another problem in getting people's agreement about how safe things need to be is that our approach to safety is often patchy and compartmentalised. This is because **risk perception** is just as variable as **risk acceptance**. For example, we can be very concerned about worrying, but in reality quite remote risks, like "stranger danger" for children or possible health effects from certain foodstuffs but quite relaxed about much bigger risks like those associated with road traffic, trampolines, barbecues or handling hot liquids.

DIAGRAM 19: Paul Slovik's risk perception plot



Two factors, unknown risk and dread, affect lay people's risk perception. Within each quadrant are samples of activities as rated by lay people.

People's perceptions of risks are influenced by factors such as whether their effects are likely to be ordinary or catastrophic, immediate or delayed or whether they affect individuals or society generally. They are also affected by whether the hazards involved are:

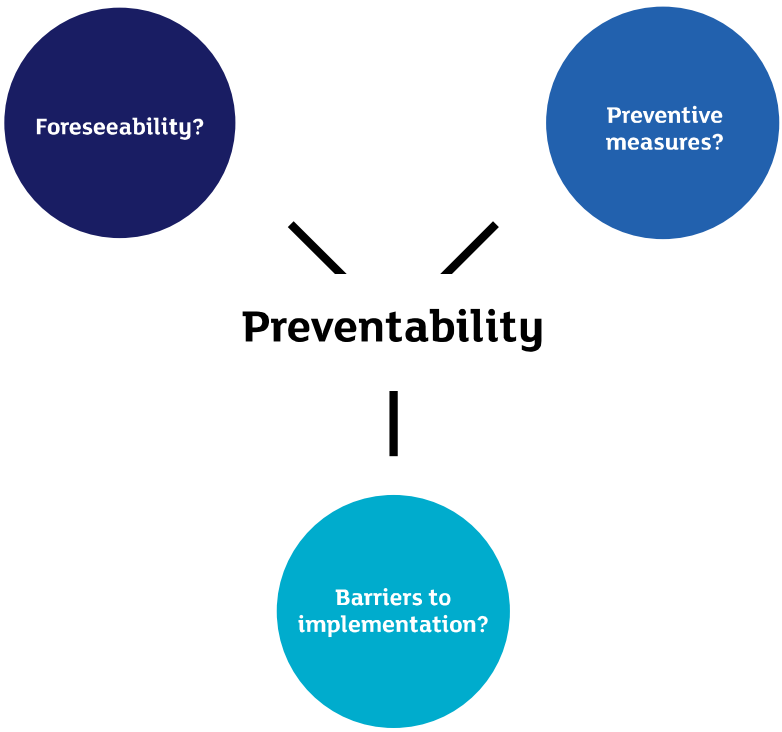
- natural or man made
- familiar or unfamiliar
- controllable or uncontrollable
- whether exposure to them is voluntary or involuntary or involves some benefit.

The way people feel about risks is also heavily influenced by the extent to which they trust the judgement of experts.

7) Preventability

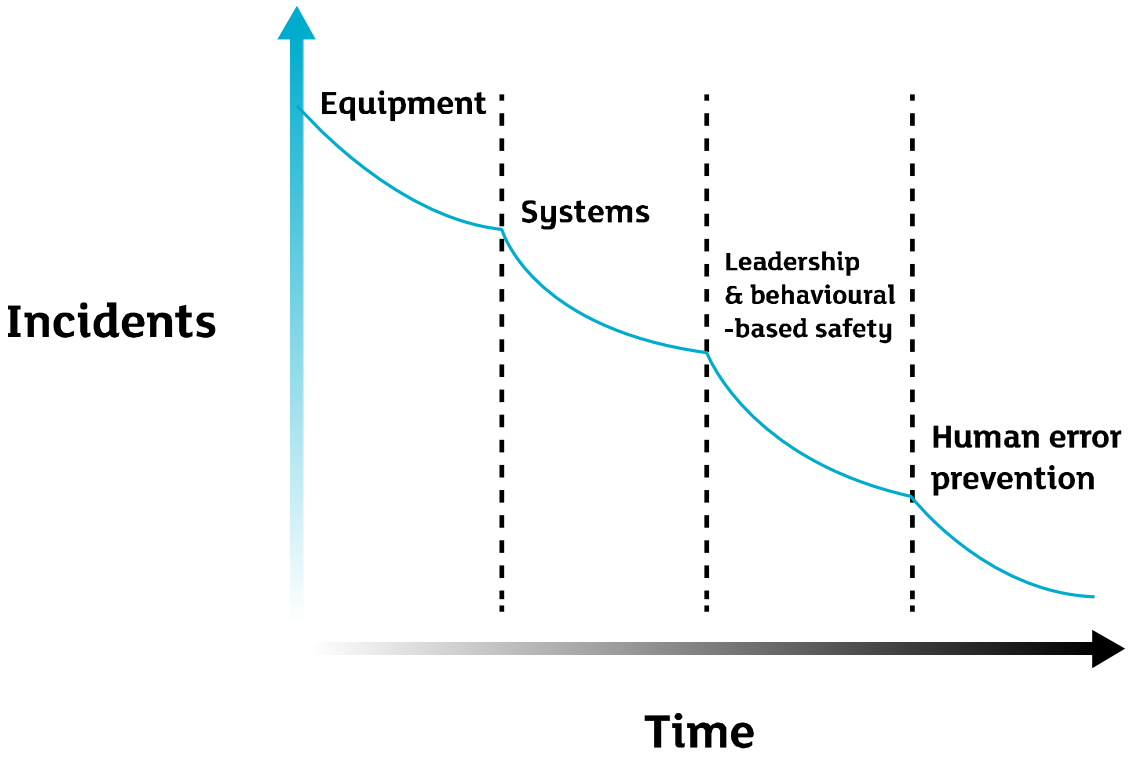
Some people argue that not all accidents are preventable. Investigation of accidents however (even with hindsight bias) shows that key factors determining **preventability** include: foreseeability of risk; availability of adequate control measures; and barriers to their application and maintenance. In most safety domains, the number of very-hard-to-prevent accidents is actually very small.

Diagram 20: Preventability?



Others in “safe” organisations may argue that the scope for reducing accidents through action at source of hazards and through better organisation is exhausted and reliance has thus to be placed on behavioural safety and error reduction. But this is not always confirmed by the results of structured investigations that examine immediate and underlying causes in some depth. There is usually scope for better preventive action at many points.

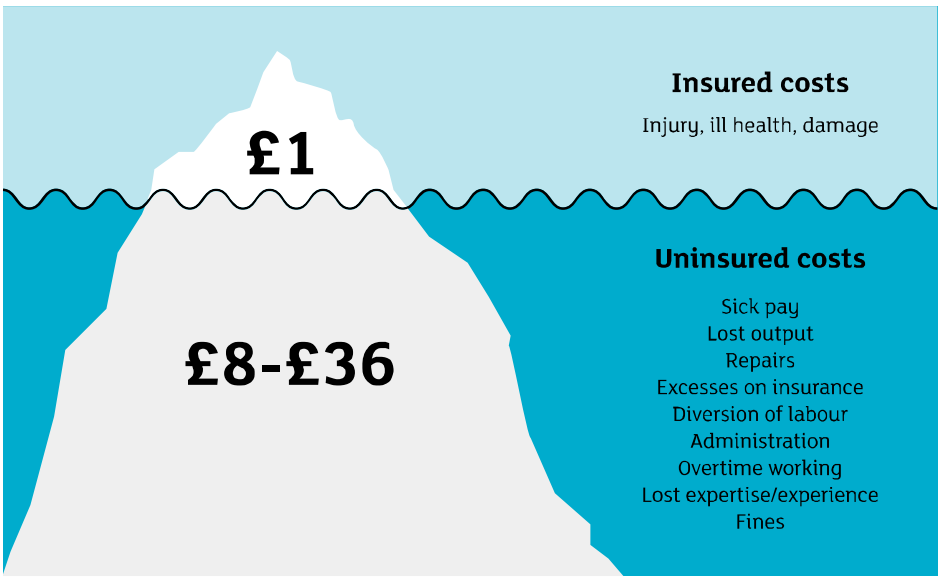
DIAGRAM 21: The Bradley curve



Others may argue that further accident prevention is just **too costly**. But if you think safety is expensive, try having an accident!

Remember, insuring against accidents is much less effective than preventing them.

DIAGRAM 22: Cost Iceberg Model



8) Management systems and safety culture

In organisations, good safety performance is a function of systematic **management** characterised by effective leadership, real workforce involvement and access to competent advice. “High-reliability organisations” are characterised by: a pre-occupation with failure; a reluctance to simplify; sensitivity to operations; a commitment to resilience; deference to expertise; and “organisational mindfulness”.

DIAGRAM 23: POPIMAR

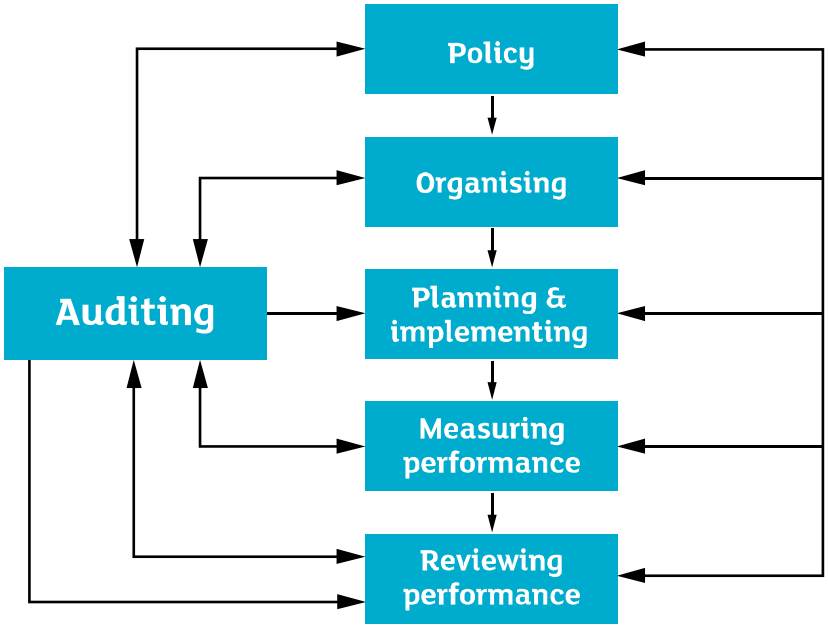
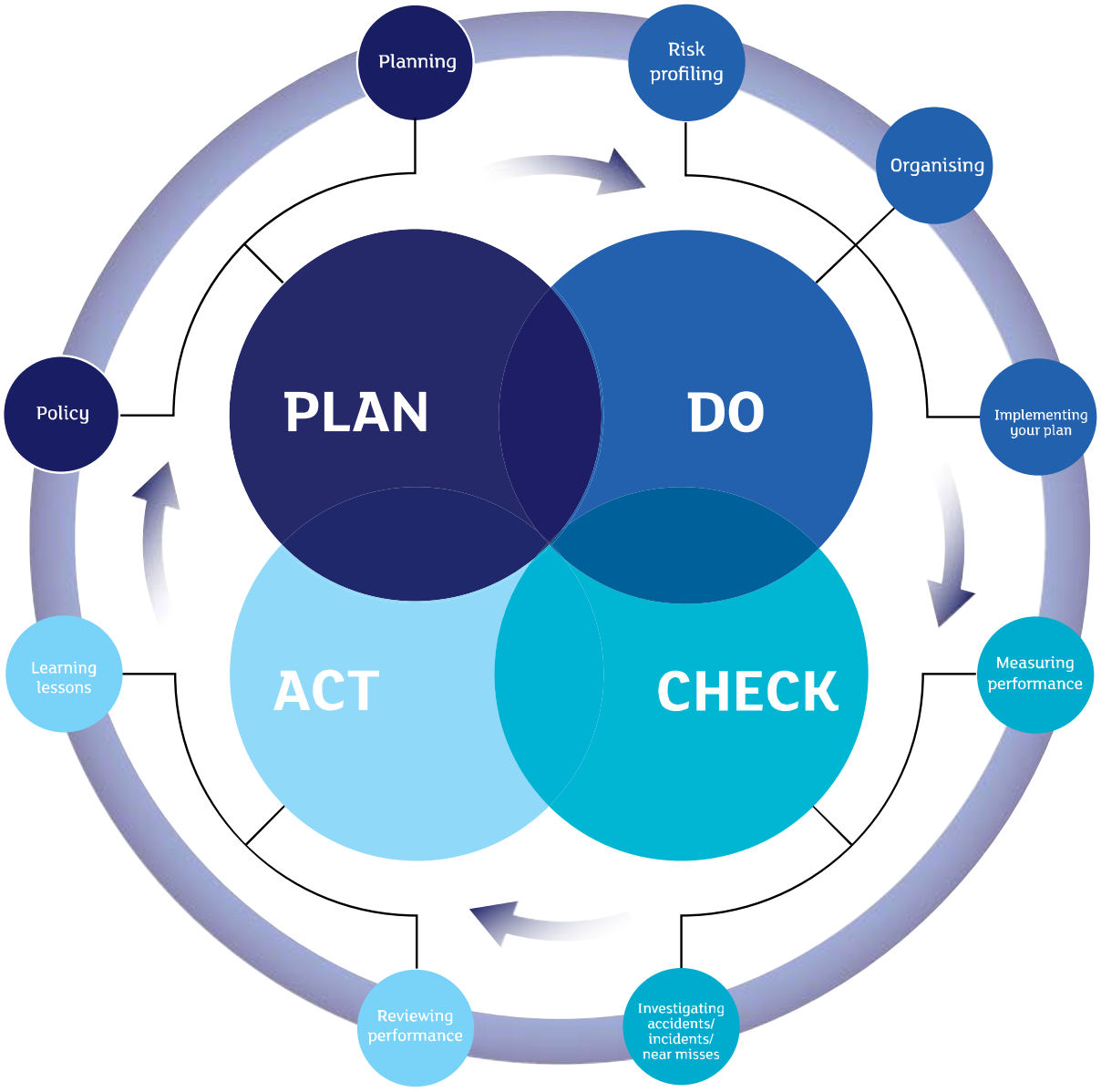
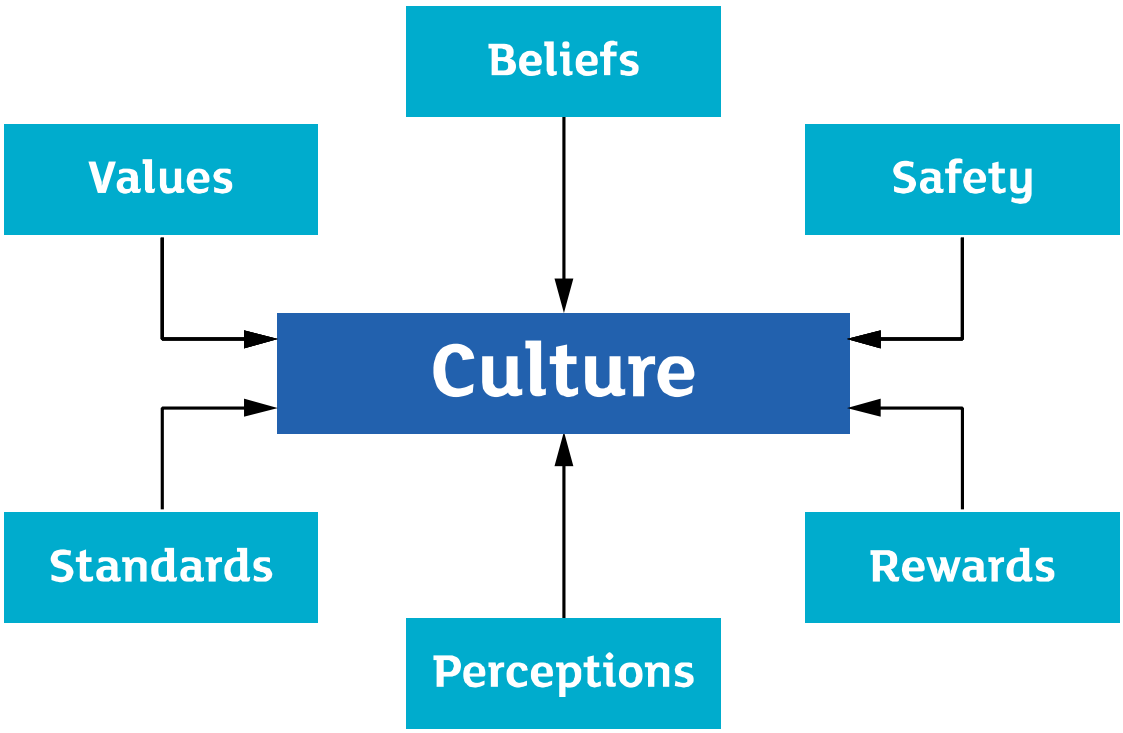


DIAGRAM 24: The Plan, Do, Check, Act cycle



But assurance of safety is not only about formal systems. It's also about the underlying **safety culture** that in any context – be that a family, a sports club or a business – ensures that action is taken consistently by everyone to achieve a good "fit" between overall safety objectives and operational realities at the sharp end.

DIAGRAM 24: Safety culture



Knowing how to make things suitably safe and ensure the safety of oneself and others can be quite challenging. But before safety can become common sense, it has to become common knowledge!

Taking time out to think about how to apply these fundamental ideas in practice might just save a life, even your own!

Dr Karen McDonnell, occupational health and safety policy adviser
February 2017