OHS Body of Knowledge

Hazard as a Concept

Core Body of Knowledge for the Generalist OHS Professional

Second Edition, 2019

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Acknowledgements

The Australian Institute of Health and Safety (AIHS) financially and materially supports the *OHS Body of Knowledge* as a key requirement of the profession.

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Bibliography

ISBN 978-0-9808743-2-7

First published in 2012

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Second Edition published in 2019

This chapter is re-published with updated references, consideration of psychosocial hazards and revised implications for practice.

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Citation of the whole *OHS Body of Knowledge* should be as:

AIHS (Australian Institute of Health and Safety). (2019). *The Core Body of Knowledge for Generalist OHS Professionals*. 2nd Ed. Tullamarine, VIC: Safety Institute of Australia.

Citation of this chapter should be as:

Pryor, P. (2019). Hazard as a Concept. In *The Core Body of Knowledge for Generalist OHS Professionals*. 2nd Ed. Tullamarine, VIC: Australian Institute of Health and Safety.

Hazard as a Concept

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Hazard as a Concept

Abstract

In occupational health and safety (OHS), the term 'hazard' is defined and used in many different ways. In introducing a series of hazard-specific chapters in the OHS Body of Knowledge, this chapter considers some of the issues associated with these various definitions and applications, including, for example, the common misidentification of failures of controls as hazards and equating hazard with risk. This chapter discusses a range of definitions and classification systems for hazards and proposes that while different definitions and classification systems may be useful depending on the context of the OHS activity; extended discussion on the topic is advocated. This discussion needs to acknowledge that multiple hazards may be present in many situations, and that workplaces are inherently complex systems. While different definitions and classifications of hazards may be tailored to different contexts and purposes, the chapter concludes that the fundamental test as to whether something is a hazard is that if it is eliminated there is no risk.

Keywords

hazard, hazardous, risk, energy, complex systems

Contextual reading

Readers should refer to 1 *Preliminaries* for a full list of chapters and authors and a synopsis of the OHS Body of Knowledge. Chapter 2, *Introduction* describes the background and development process while Chapter 3, *The OHS Professional* provides a context by describing the role and professional environment.

Terminology

Depending on the jurisdiction and the organisation, Australian terminology refers to 'Occupational Health and Safety' (OHS), 'Occupational Safety and Health (OSH) or 'Work Health and Safety' (WHS). In line with international practice this publication uses OHS with the exception of specific reference to the Work Health and Safety (WHS) Act and related legislation.

Jurisdictional application

This chapter includes a reference to the Australian model work health and safety legislation. This is in line with the Australian national application of the *OHS Body of Knowledge*. Readers working in other legal jurisdictions should consider these references as examples and refer to the relevant legislation in their jurisdiction of operation.

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1 Introduction

In occupational health and safety (OHS), the term 'hazard' is defined and applied in many different ways. As the use of terminology is fundamental to common understanding, lack of clarity on the meaning of hazard can pose a significant barrier to the achievement of effective hazard management in the workplace

This chapter addresses some of the issues associated with the term 'hazard' with the aim of setting the context for several hazard-specific chapters in the OHS Body of Knowledge. It discusses some classifications of hazards and considers conceptual implications for OHS practice and for how the OHS Body of Knowledge is structured. It is not the intention to advocate for adoption of any specific definition of hazard, but rather to stimulate informed discussion in the pursuit of a common understanding of hazards, their definitions and classifications to underpin their effective management.

2 'Hazard' definitional issues

The term 'hazard' is used in many contexts. In a community context, for example, references are made to meteors, earthquakes and floods as 'natural hazards' golfers refer to 'playing the hazard' and hazard is sometimes used as a verb (e.g. to 'hazard a guess'). A *Google* search for 'definition of hazard not financial or insurance' conducted in 2019 resulted in more than 41 million hits; some of these present 'hazard' as synonymous with 'risk,' while others adopt the more common 'source of harm' usage.

2.1 Scope of definitions

It might be expected that narrowing the search to OHS sources would clarify the OHS-specific meaning of hazard, but this is not the case. An abundance of different OHS-specific definitions have been proposed. The International Labour Organization (ILO) defined a hazard as "The inherent potential to cause injury or damage to people's health" (ILO, 2010, p. 15). While this conception is open to encompassing all types of hazard, the resultant vagueness makes it difficult to apply. While similarly generic, the definition provided by the International Standards Organization (ISO) in the standard ISO45001 *Occupational health and safety management systems – Requirements with guidance for use* refers to a hazard as: "a source with a potential

for injury and ill health" (SA/SNZ, 2018; p. 4). This definition moves the concept of hazard from the vague "potential" to the only slightly less vague "source".

It is notable that the definitions in Part 1.1 of the Australian Model Work Health and Safety Regulations (WHSR) (SWA, 2019) do not include a definition of 'hazard' although they do refer to "hazard class" and "hazard category" (as in the Globally Harmonised System of Classification and Labelling of Chemicals) and specifically define a "hazardous chemical" and a "hazardous manual handling task". The Code of Practice *How to manage work health and safety risks* (SWA, 2018) defines hazard as "a situation or thing that has the potential to harm a person". (p. 26). Thus we now move to the source being a 'situation' or thing'.

Australia's *Type of Occurrence Classification System* (SWA, 2008) added another dimension to the hazard-definition discussion in that it bypassed the term entirely in favour of "agency of injury or disease," which it defined as "the object, substance or circumstance directly involved in inflicting the injury or disease;" examples include falls, heat, radiation, sound and pressure, and body stressing, which, conceptually are hazards.

2.2 Confusion with 'failures in control'

In 2012, an examination of definitions for 'hazard' revealed a number of citations where failures in control were given as examples of hazards. For example:

- Safe Work Australia

  … Hazards at work may include: noisy machinery, a moving forklift, chemicals, electricity, working at heights, a repetitive job, bullying and violence, a <u>badly designed workplace and inadequate management systems (for example, no procedures for performing tasks safely).</u> (emphasis added) (Safework Australia, 2010).

- The Canadian Centre for Occupational Health and Safety

  Listed a category of "safety" hazards that included "<u>inappropriate machine guarding, equipment malfunctions or breakdowns</u>" (emphasis added) (CCOHS, 2009)

These underlined examples are failures in control; they are <u>not</u> hazards but are part of the process that gives rise to the injury or damage rather than the hazard itself.

Including such preconditions in the definition leads to millions of possibilities and so renders the term 'hazard' meaningless.

It is pleasing that in 2019 many of the OHS authorities and others have refined their explanation of a hazard to exclude such erroneous examples. However, there is still lack of clarity in the varying definitions of hazard as evidenced in the following examples:

Canadian Centre for Occupational Health and Safety (CCOHS, 2019a)

> Workplace hazards can come from a wide range of sources. General examples include any substance, material, process, practice, etc. that has the ability to cause harm or adverse health effect to a person or property.

Examples given include: wet floor, welding, hard rock mining; and entanglement in rotating equipment. While each of these are associated with hazards, none of them are hazards in themselves.

A quote from online training for workers in the community services sector also demonstrates this confusion between hazards and failures in control:

> "Some items are hazardous by nature, while others only become hazardous if used inappropriately or carelessly." (emphasis added) (QCOSS Community Door, n.d.),

The Western Australian Department of Mines, Industry Regulation and Safety includes in the examples of hazards "inappropriate behaviour that adversely affects worker's safety and health" (DMIRS, n.d.), a phrase which may be open to a range of interpretations.

2.3 Confusion with 'risk'

Another aspect of the terminology issue is that hazard is often confused with risk, and similar definitional problems apply to risk[1] as to hazard. While the two concepts are closely linked, there is an important difference – risk refers to *outcomes* (or consequences) whereas hazard relates to a *source* of risk. In addition, risk is about uncertainty and is context and circumstance dependent (SA/SNZ , 2009); hazards, on the other hand, are either present or not. The two concepts are not interchangeable, and it can be problematic when confusion surrounds their use. Interestingly, while the now-superseded standard *AS/NZS 4360:2004 Risk Management* defined a hazard as "a source of potential harm" (SA/SNZ, 2004), the

[1] See *OHS BoK* 31.1 Risk.

international standard *AS/NZS ISO 31000:2009* which replaced it elected to refer instead to “risk sources” defined as “elements which alone or in combination have the intrinsic potential to give rise to risk” (SA/SNZ, 2009, p. 4).

3 Hazard as a ‘source of potentially damaging energy’

Turning to the OHS professional literature, one of the earliest attempts to define hazards in an OHS context is the concept of hazards as “sources of potentially damaging energy”. The origin of the definition of hazards in terms of energy is usually attributed to Gibson who published in 1961 with the definition and concept being elaborated on by Haddon and Wigglesworth in 1973 and further refined by Viner who defined hazards as:

> Sources of potentially damaging energy which either exist naturally or as a result of humankind’s modification of the naturally occurring world...where damage (injury) is the result of an incident energy whose intensity at the point of contact with the recipient exceed the damage threshold of the recipient (Viner, 1991, p. 42).

The definition of a hazard as a source of potentially damaging energy is the basis for several models of accident causation (refer Viner, 1991).[2]

The concept of a hazard as a source of potentially damaging energy is a useful one for the OHS professional; it has relevance for understanding causation and for proactive identification of hazards as a basis for taking action. However, the energy-damage model has its limitations. It is not particularly helpful for understanding the complexities of the damage process in situations where there is an appreciable human-factor component, where the effects of a hazard have a long latency period, where damage may be the result of more than one hazard or the interaction of several hazards, and in considering system complexity. These limitations are discussed below.

[2] See also *OHS BoK* 32 Models of Causation - Safety

3.1 Limitations of the energy-damage conception of hazard

3.1.1 Hazards where effects have a long latency period

There are occasions when damage or ill health is manifested and investigators of OHS problems must retrospectively determine the hazard(s) that was the source(s) of the effect(s). During a long latency period (e.g. it is not uncommon for asbestos exposure to result in disease 40 years post-exposure), various work and personal circumstances can influence the outcome of the harm, making detection of the specific hazard(s) difficult. In such situations, simplistic definitions of hazards and the energy-damage definition are of limited value.

3.1.2 Multiple hazards

In cases where the type of risk (i.e. the possible injury or harm to health) stems largely or entirely from *one* type of hazard, the issues surrounding terminology might not be problematic. However, harm may result from the interaction of several hazards, such as the synergistic effect of psychosocial and biomechanical hazards[3] and ototoxic chemicals that, in combination with noise, have a more detrimental effect on hearing than noise alone.[4] In such cases, the 'damaging energies' concept may result in risks being controlled independently of each other (Macdonald, 2005).

3.1.3 Situations with a high human-factor component

Applying the concept of hazards as potentially damaging energy is not particularly helpful when the expression of damage is affected by human-factor components, such as in biomechanical or manual-task-related hazards and psychosocial hazards. The expression of biomechanical hazards may be determined by human factors such as age, gender, fitness, anthropometry and technique. While the 'human factors' may be explained by the

> damage (injury) [being] the result of an incident energy whose intensity at the point of contact with the recipient exceed[s] the damage threshold of the recipient (emphasis added) (section 3). (Viner, 1991.)

[3] See *OHS BoK* 16 Biomechanical.

[4] See *OHS BoK* 22 Noise and vibration.

The potentially damaging energy definition for hazards does not allow for complex interaction of human factors on the expression of a hazard.[5]

3.1.4 Hazards arising from complexity

Recent research and discussions focus on OHS as part of complex systems.[6] From such a perspective, the OHS professional must consider the functioning of the whole organisational system and comprehend how different elements and processes act together when exposed to a range of influences simultaneously, rather than just search for broken parts (Dekker, 2011, p. 127). Traditional OHS models are based on the premise that for incidents to happen, something or someone must break or malfunction. However, many writers (Rasmussen, 1997; Dekker and others) have described a phenomenon of 'drift' where organisations fail because they normalise very small changes to parameters until the system as a whole drifts into an unsafe state. While constant adaptation is a requirement for success of complex systems, organisations are subject to constant pressures deriving from efficiency and cost imperatives which can bring the system into a 'brittle' situation where the ability to adapt to a change in circumstances is reduced to a critical level.

Furthermore, in our efforts to manage safety by increasing reliability we tend to add redundancy which adds to the complexity of our systems. While this redundancy in safety critical systems may be essential it also adds to the complexity of the system which can intensify the outcomes of a system failure. This can happen without anything breaking, or without anybody actively erring or violating rules.

The interactions within and between complex systems are not particularly well understood as the growth of complexity in society and organisations has outpaced our understanding of how they work and fail (Dekker, 2011, p. xiii). In light of these observations, definitions of hazards may need reconceptualising and further revision as our understanding develops.

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[5] See section 4.4 for a discussion psychosocial factors.

[6] See *OHS BoK* 12.1 Systems.

4 Classifications of hazards

Classifying things into categories is a way of imposing some order on, and increasing our understanding of, our environment (e.g. classification of biological organisms imposes order on the biological world to increase understanding). While many OHS sources provide lists of example hazards, there have been some attempts to classify hazards based on a unifying concept. It is debatable, however, whether some of these classifications serve to increase understanding or simply add to the confusion surrounding hazards. Three hazard classification systems are outlined below.

4.1 A common classification

A commonly used classification includes the following five categories of hazard:

- Psychosocial: stress, violence and other workplace stressors.
- Biological: bacteria, viruses, other micro-organisms, insects, plants, animals
- Chemical: toxicants, toxins that affect the body or chemicals that lead to fire or explosion
- Ergonomic:[7] repetitive movement, manual handling, workplace design, job and task design
- Physical: electricity, radiation, pressure, noise, heights, vibration

(See for example Comcare, 2016)

Some sources have made variations to the categories in this common classification system; for example, the Canadian Centre for Occupational Health and Safety (2019) use the categories: psychosocial, chemical, ergonomic; but also add health; safety and workplace as separate categories.

4.2 Energy-based hazard classification

Energy-based classifications focus on established types of energy. Viner (1991) provided a detailed list with examples (Table 1).

[7] While the term 'ergonomic' is commonly used in these classifications it perhaps should be re-titled 'biomechanical' as ergonomics is the science of work and is concerned with the design of safe and efficient workplaces and processes, and is not a category of hazard.

Table 1: Sources of energy as basis for a classification of hazards (Viner, 1991)

Energy Type	Sub-type or Description
Potentially injurious or damaging energy sources external to the injured person or damaged body	
'Potential energies'	Gravitational energy, structural strain energy, stored energy in compressed fluids
Kinetic energy	Energy stored in a body's mass due to its speed in linear or rotational motion
Mechanical power	The rate of energy flow in machinery from the source of power to the point where the energy is absorbed in the action of the machine
Acoustic and mechanical vibrations	Noise, acoustic shock waves, mechanical vibration in solids
Electrical energy	Electrical potential energy (volts), electromagnetic vibration, electrostatic charge
Nuclear particle radiation	Radiation of nuclear origin
Thermal energy	Solids, liquids, gases (including flames) Ambient (atmospheric conditions)
Chemical energy	Molecular bonding energy released in oxidising actions (fire and explosion) Modification to the chemical processes of the body (acute toxic and non-respirable conditions)
Microbiological 'energy'	Viruses, bacteria, fungi
Muscle energy	Attacks (purposeful) or inadvertent striking
Potentially injurious or damaging energy sources within the injured person or damaged body	
Gravitational potential energy	Due to height above a datum
Kinetic energy	In body movement (self-generated or externally powered)
Muscle energy	In the maintenance of body posture, in undertaking physical work and force application, in the generation of movement
Chemical energy	Molecular bonding energy released in oxidising reactions

While Viner included "internal kinetic energy" and "muscle energy" in his list of sources of energy as a way of addressing hazards associated with manual tasks or biomechanical hazards, many OHS professionals and educators may perceive this as 'forcing' the energy-based categorisation to fit all circumstances. It is more useful perhaps to apply the energy classification in circumstances where it is appropriate while noting the limitations.

4.3 Contextual classification of hazards

Another set of categories was proposed by Macdonald (2005), who expressed concern about the limitations arising from definitions that imply that a hazard must have a finite, physical presence. Macdonald proposed differentiation of hazard categories according to different elements of the work system (Table 2).

Table 2: Classification of hazards taking account of context and conditions (Macdonald, 2005)

Category	Definition	Examples
Hazardous substance or object	A specific object that increases risk to health in its immediate spatial or temporal vicinity	A hazardous chemical or biological agent; An object on a path that could be tripped over; An unguarded machine blade; A vehicle moving at significant speed; A poorly designed hand tool.
Hazardous activity	A work task or activity that is inherently a potential source of risk, so that workers are exposed to one or more of the following: …	Biomechanical hazards … e.g. heavy lifting, highly repetitive movements, prolonged static postures Psychosocial hazards … e.g. work that is likely to cause psychological stress (link), due to factors such as: extended periods of external pacing at a high rate with short cycle times; personal interactions with aggressive or abusive clients, etc
Hazardous personal condition	Ongoing, sub-optimal conditions of workers that increase their personal vulnerability to hazardous activities and conditions	Pre-existing injuries; States of chronic fatigue or stress due to factors such as inadequate sleep, poor work-life balance; Sub-standard competence in performing normal work tasks.
Hazardous system condition	A condition of any component of the system (equipment, workstation, work procedures and organisation, job design, management system, physical and psychosocial environments) that increases risk	Very cold environment; Inadequate staffing level; Absent or inadequate resources (e.g. lifting aids, information, equipment, emotional support); Inadequate time to complete required work; Piece-rated payment system; Very long working hours; Badly designed shift rotation system; Management system that results in workers having inadequate levels of: control or decision latitude, performance feedback, recognition/reward of effort and good performance.
Hazardous personal state	A more transient personal state, typically chronic stress or fatigue, that results from one or more of the above factors and increases risk – directly to that individual	Due to physiological effects of the stress response, or overloading/overexertion of specific body tissues; or Indirectly due to performance degradation and a consequent increase in errors that increase injury risk

Some of these categories conform to the common understanding of a hazard as a 'thing;' others, particularly those listed by Macdonald as psychosocial hazards and hazards relating to ongoing conditions of 'the system' are referred to as 'hazardous conditions'. Some OHS professionals would consider Macdonald's "hazardous personal condition", "hazardous system condition" and "hazardous personal state" categories to be risk factors rather than hazards. Moreover, some examples provided for the hazardous personal and system conditions, such as substandard competence or lack of equipment, would be perceived by OHS professionals as failures in controls. Indeed, several of Macdonald's categories correlate with Reason's (1997) "latent failures" or "unsafe conditions." Consequently, it can be argued that this is an example of a classification system that goes beyond 'hazard.'

Another and perhaps more useful way of looking at hazards 'in a context' is provided by Susanne Tepe who coined the phrase "a hazard becomes a risk within a context" (personal communication, July 9, 2019)[8]. A butane-fuelled cigarette lighter may be banned within a petrochemical complex, not because of the butane, but because it can cause a flame, as can a match. Thus, while the butane may be a chemical hazard, the lighter is useful when a flame is required but is a risk in a flammable environment when a flame can have disastrous consequences.[9]

4.4 Psychosocial hazards

Psychosocial hazards have increasingly been a topic of concern and attention since the first publication the OHS Body of Knowledge in 2012 and this is reflected in the current Australian WHS legislation with the Model Work Health and Safety Act, 2016 (s 4) (SWA, 2016) defining health as meaning physical and psychological health.

Discussion of psychosocial hazards often focuses on 'workplace stress', bullying and violence (see for example CCOHS, 2019b) however the formal definitions tend to emphasise the dynamic interaction between the work environment and human factors. This dynamic nature is addressed in the definitions of psychosocial hazards issued by the ILO and Safe Work Australia.

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[8] Associate Professor, Occupational Health and Safety, RMIT University, Victoria, Australia.

[9] Note, this could still be considered consistent with the energy definition of a hazard which refers to "an incident energy whose intensity at the point of contact with the recipient exceed the damage threshold of the recipient". Section 3.

The ILO defines psychosocial hazards as:

> The interactions between and among work environment, job content, organizational conditions and workers' capacities, needs, culture, personal extra-job considerations that may, through perceptions and experience, influence health, work performance and job satisfaction" (ILO, 1986, p. 3).

The national guidance material published by Safe Work Australia on work-related psychological health and safety defines psychosocial hazards as:

> Factors in the design or management of work that increases the risk of work-related stress which can then lead to psychological or physical harm. (SWA, 2019, p. 37)

Examples cited by Safe Work Australia include: high job demands; low job demands; low job control; poor support; poor workplace relationships; poor organisational change management; low recognition and reward; poor organisational justice; poor environmental decisions; poor environmental conditions; remote work; isolated work; violent or traumatic events. (SWA, 2019, pp. 8-11.)

The breadth and interactive nature of psychosocial hazards means that they are best discussed as a separate hazard category.[10]

5 Implications for practice

A shared language and shared understanding is an important component of professional practice. While there is improved clarity and consistency in defining a 'hazard', the current definitional variations across OHS authorities, nationally within Australia, internationally and within the community, detract from a consistent approach to hazard identification and management.

The author is of the opinion that broad, all-encompassing definitions of hazards such as "a situation or thing that has the potential to harm" (Safe Work Australia, 2018) are of limited use for the OHS professional engaging with workplace personnel in identifying hazards. The OHS professional may find it more useful to apply a definition of hazard that is appropriate to the situation at the time. For example, in developing a checklist for workplace inspections, it may be appropriate for a simple, energy classification system to underpin the list of physical or chemical hazards to be inspected, if that is the scope of the inspection. However, when speaking with

[10] See OHS BoK 19 Psychosocial Hazards, 20 Fatigue, 21 Bullying, Aggression and Violence.

senior management, it may be appropriate to use a more multifaceted classification system that recognises aspects of latent conditions and psychosocial hazards. In incident investigation, it may be useful to use both these classifications and more to describe systemic failures. As our understanding of system complexity evolves, it may be necessary to further adapt our classifications of hazard to acknowledge dangerous conditions that emerge from seemingly safe elements interfacing with other seemingly safe elements.

The generalist OHS professional should be familiar with the various definitions and classifications of hazards (which extend beyond those discussed in this chapter), and their evolution and conceptual underpinning. Also, they should be able to discuss the nature of hazards and rationalise their understanding of hazards to move to a more consistent, shared understanding of hazards. The primary objective in OHS practice is to get the basics right and the basics are not likely to be in place when failures in controls are confused with hazards, or with risk. As stated by Cross[11] **the fundamental test as to whether something is a hazard is that if it is eliminated there is no risk**.

6 Summary

To facilitate clarity of presentation, the hazard-specific chapters in the OHS Body of Knowledge consider individual hazards. However, OHS professionals and educators need to apply this knowledge in a way that recognises that multiple hazards may be present in many situations, and that workplaces are inherently complex systems.

Knowledge evolves as people engage with it. OHS professionals, educators, researchers, policy makers and regulators should all engage in discussion about hazards, and the definitions and classifications of hazards, with the view of arriving at a shared understanding. This may include tailoring different definitions and classifications of hazards to different contexts and purposes, and modifying these as our understanding of complex systems and systemic failure develops.

[11] See *OHS BoK* 31.1 Risk.

Key thinkers

Haddon, Wigglesworth, Viner, Dekker

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