Hazard as a Concept

Core Body of Knowledge for the Generalist OHS Professional

Safety Institute of Australia Ltd

Australian OHS Education Accreditation Board

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

HaSPA (Health and Safety Professionals Alliance).(2012). *The Core Body of Knowledge for Generalist OHS Professionals.* Tullamarine, VIC. Safety Institute of Australia.

Citation of individual chapters should be as, for example:

Pryor, P., Capra, M. (2012). Foundation Science. In HaSPA (Health and Safety Professionals Alliance), *The Core* Body *of Knowledge for Generalist OHS Professionals.* Tullamarine, VIC. Safety Institute of Australia.

The OHS Body of Knowledge for Generalist OHS Professionals has been developed under the auspices of the **Health and Safety Professionals Alliance**

The Technical Panel established by the Health and Safety Professionals Alliance (HaSPA) was responsible for developing the conceptual framework of the OHS Body of Knowledge and for selecting contributing authors and peer-reviewers. The Technical Panel comprised representatives from:

The Safety Institute of Australia supported the development of the OHS Body of Knowledge and will be providing ongoing support for the dissemination of the OHS Body of Knowledge and for the maintenance and further development of the Body of Knowledge through the Australian OHS Education Accreditation Board which is auspiced by the Safety Institute of Australia.

Synopsis of the OHS Body of Knowledge

Background

A defined body of knowledge is required as a basis for professional certification and for accreditation of education programs giving entry to a profession. The lack of such a body of knowledge for OHS professionals was identified in reviews of OHS legislation and OHS education in Australia. After a 2009 scoping study, WorkSafe Victoria provided funding to support a national project to develop and implement a core body of knowledge for generalist OHS professionals in Australia.

Development

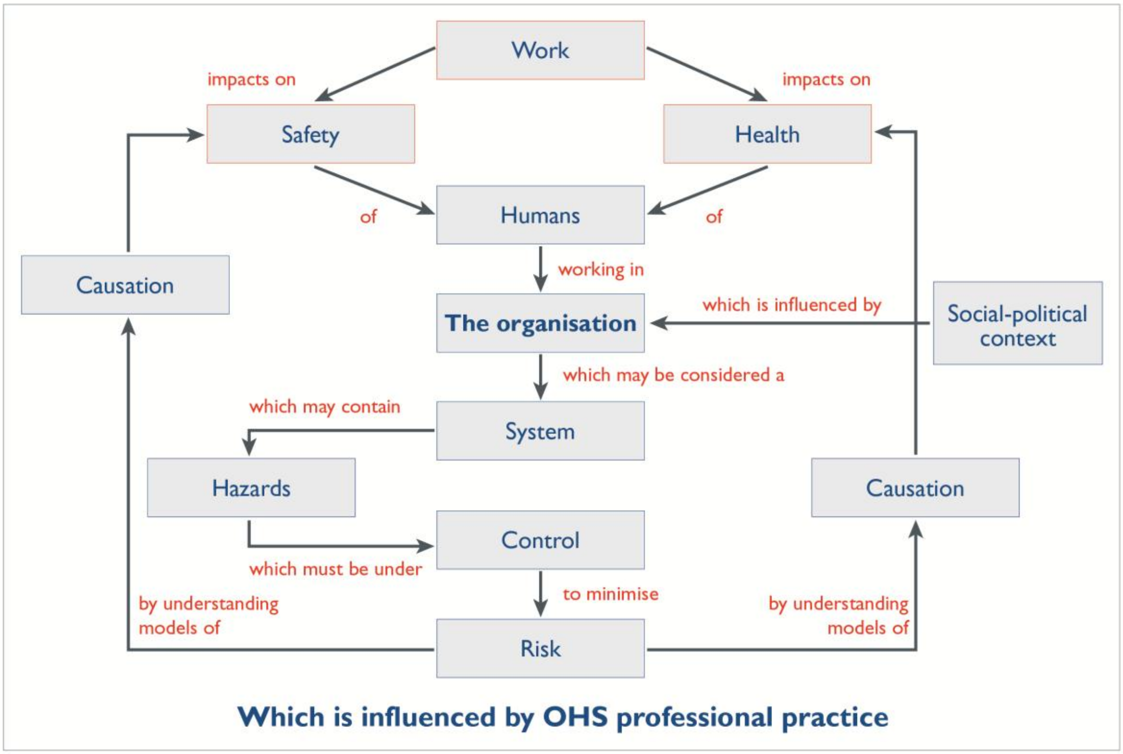
The process of developing and structuring the main content of this document was managed by a Technical Panel with representation from Victorian universities that teach OHS and from the Safety Institute of Australia, which is the main professional body for generalist OHS professionals in Australia. The Panel developed an initial conceptual framework which was then amended in accord with feedback received from OHS tertiary-level educators throughout Australia and the wider OHS profession. Specialist authors were invited to contribute chapters, which were then subjected to peer review and editing. It is anticipated that the resultant OHS Body of Knowledge will in future be regularly amended and updated as people use it and as the evidence base expands.

Conceptual structure

The OHS Body of Knowledge takes a 'conceptual' approach. As concepts are abstract, the OHS professional needs to organise the concepts into a framework in order to solve a problem. The overall framework used to structure the OHS Body of Knowledge is that:

> **Work** impacts on the **safety** and **health** of humans who work in **organisations**. Organisations are influenced by the **socio-political context**. Organisations may be considered a **system** which may contain **hazards** which must be under control to minimise **risk**. This can be achieved by understanding **models causation** for safety and for health which will result in improvement in the safety and health of people at work. The OHS professional applies **professional practice** to influence the organisation to being about this improvement.

This can be represented as:



Audience

The OHS Body of Knowledge provides a basis for accreditation of OHS professional education programs and certification of individual OHS professionals. It provides guidance for OHS educators in course development, and for OHS professionals and professional bodies in developing continuing professional development activities. Also, OHS regulators, employers and recruiters may find it useful for benchmarking OHS professional practice.

Application

Importantly, the OHS Body of Knowledge is neither a textbook nor a curriculum; rather it describes the key concepts, core theories and related evidence that should be shared by Australian generalist OHS professionals. This knowledge will be gained through a combination of education and experience.

Accessing and using the OHS Body of Knowledge for generalist OHS professionals

The OHS Body of Knowledge is published electronically. Each chapter can be downloaded separately. However users are advised to read the Introduction, which provides background to the information in individual chapters. They should also note the copyright requirements and the disclaimer before using or acting on the information.

Hazard as a Concept

Pam Pryor BSc, BEd, GDipOHM, FSIA
Secretary, SIA OHS Education Chapter
Sessional Lecturer, Senior Research Fellow and PhD candidate, University of Ballarat
Email: pampryor@ballarat.edu.au

Pam has qualifications in education and OHS, and has been a practising OHS professional for more than 25 years. She was a technical advisor in OHS skills development to the National Occupational Health and Safety Commission. Pam was the SIA representative on the Technical Panel for the OHS Body of Knowledge project and chair of the Technical Panel.

The OHS Body of Knowledge Technical Panel
Chair: Pam Pryor (SIA)
Dr David Borys (University of Ballarat)
Professor Mike Capra (SIA)
Associate Professor Wendy Macdonald (La Trobe University)
Dr Jodi Oakman (La Trobe University)
Leo Ruschena (RMIT University)
Associate Professor Susanne Tepe (RMIT University)

Peer reviewers
Professor Chris Winder BA(Hons), GCertOHSMgt, MSc, PhD, FSIA
Risk and Safety Sciences Group, University of New South Wales

Dr Steve Cowley PhD, BSc(Hons)(OHS), MSc(OccHyg), GCert(Ed), FSIA, RSP
Steve Cowley Health & Safety Consulting

Core Body of Knowledge for the Generalist OHS Professional

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. This chapter discusses a range of definitions and classification systems for hazards and proposes that different definitions and classification systems may be useful depending on the context of the OHS activity; extended discussion on the topic is advocated. While subsequent hazard chapters are organised in accordance with the energy classification system, the generalist OHS professional should apply the knowledge in a way that recognises that multiple hazards may be present in complex systems.

Keywords

hazard, hazardous, risk, energy, complex systems

Contents

1 Introduction 1

2 'Hazard' definitional issues 1

2.1 Limitations of the energy-damage conception of hazard 3

3 Classifications of hazards 4

3.1 A common classification 4

3.2 Energy-based hazard classification 5

3.3 Contextual classification of hazards 6

4 Implications for practice 7

5 Implications for the OHS Body of Knowledge 8

Key thinkers 8

References 9

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 poses 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 adoption of any specific definition of hazard, but rather to stimulate informed discussion from a common understanding of hazards, their definitions and classifications.

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' results in more than 7 million hits; some of these present 'hazard' as synonymous with 'risk,' while others adopt the more common 'source of harm' usage.

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 (International Labour Organisation), p. 15). While this conception is open to encompassing all types of hazard, the resultant vagueness makes it difficult to apply. Another commonly used definition that is arguably only slightly more conducive to operational application is the Standards Australia/Standards New Zealand (SA/SNZ) definition that refers to a hazard as: "a source or a situation with a potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these" (Standards Australia, 2001). A similarly broad approach to hazard definition was adopted by Safe Work Australia in the 2010 draft code of practice developed to support implementation of the national Model Work Health and Safety Act:

> Hazard means a situation or thing that has the potential to harm a person. Hazards at work may include: noisy machinery, a moving forklift, chemicals, electricity, working at heights, a repetitive job, bullying and violence, a badly designed workplace and inadequate management systems (for example, no procedures for performing tasks safely) (Safework Australia, 2010).

This definition took the approach of defining a hazard as a 'thing' or 'situation'. It is also potentially confusing as it includes examples that represent not hazards, but failures in controls (i.e. "inadequate management systems" and "no procedures") that 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.

Australia's *Type of Occurrence Classification System* (National Occupational Health and Safety Commission, 2004) 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.

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 (Standards Australia/Standards New Zealand), 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" (Standards Australia, 2004), the 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 (Standards Australia/Standards New Zealand), 2009, p. 4).

Turning to the OHS professional literature, one of the earliest attempt 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).

[1] See *OHS BoK* Risk.

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.

2.1 Limitations of the energy-damage conception of hazard

2.1.1 Situations with a high human-factor component

The concept of hazards as potentially damaging energy is not 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. The expression of psychosocial hazards may be affected by factors such as self-esteem, competence and coping mechanisms. While in modern OHS practice these types of factors are unlikely to be the focus of primary control strategies, it is likely that in the future these types of factors will be the focus of secondary control strategies for psychosocial hazards.[2] This reinforces the importance of understanding the complex interactions of these factors in the expression of the hazard.

2.1.2 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.

2.1.3 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

[2] See *OHS BoK* Global concept: Health.
[3] See *OHS BoK* Hazards: Biomechanical.
[4] See *OHS BoK* Hazard: Noise and vibration.

cases, the ‘damaging energies’ concept may result in risks being controlled independently of each other (Macdonald, 2005).

2.1.4 Hazards arising from complexity

Recent research and discussions focus on OHS as part of complex systems.[5] 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 (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. In complex systems, drift into failure can happen without anything breaking, or without anybody actively erring or violating rules. Fundamentally, this challenges assumptions about cause and effect. These processes are not particularly well understood as the growth of complexity in society and organisations has outpaced our understanding of how complex systems 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.

3 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 (Workplace Health and Safety Queensland, 2008), 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.

3.1 A common classification

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

- Biological: bacteria, viruses, other micro-organisms, insects, plants, animals
- Chemical: toxicants, toxins that affect the body or chemicals that lead to fire or explosion
- Physical: electricity, radiation, pressure, noise, heights, vibration

[5] See *OHS BoK* Systems.

- Ergonomic:[6] repetitive movement, manual handling, workplace design, job and task design
- Psychosocial: stress, violence and other workplace stressors.

(See for example CCOHS, 2009)

Some sources have made variations to the categories in this common classification system; for example, Comcare Australia (2004) and the Canadian Centre for Occupational Health and Safety (2009). The latter listed a sixth potentially confusing category of "safety" hazards that included "inappropriate machine guarding, equipment malfunctions or breakdowns," which are failures in controls rather than hazards.

3.2 Energy-based hazard classification

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

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

[6] 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.

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.

3.3 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	Very cold environment; Inadequate staffing level; Absent or inadequate resources (e.g. lifting aids,

	procedures and organisation, job design, management system, physical and psychosocial environments) that increases risk	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.' 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.'

4 Implications for practice

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 them.

The definitional issues discussed have an important implication for practice – failure in control mechanisms should not be construed as a hazard. When a definition of a hazard, such as that developed by Safe Work Australia (see section 2), cites examples of a hazard such as an inappropriate guard, a lack of procedure or a lack of training, then the response will be to fit a different guard, write a procedure or provide training; by definition, the hazard defines the control option. However, if a different definition and classification had been used (e.g. moving parts of plant, a chemical or a manual handling task), different and perhaps more appropriate controls may have been suggested. 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.

In addition, 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, 2010) 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 hazards to be inspected. However, when speaking with senior management, it may be appropriate to use a more multifaceted classification system that recognises aspects of latent conditions. In incident investigation, it may be useful to use both these classifications and more to describe systemic failures. However, as stated by Cross[7] the fundamental test as to whether some thing is a hazard is that if it is eliminated there is no risk.

As our understanding of system complexity evolves, it may be necessary to adapt our classifications of hazard to acknowledge dangerous conditions that emerge from seemingly safe elements interfacing with other seemingly safe elements. The concept of ‘drift’ in systems is an example of an area of emerging knowledge that may impact the thinking and language of OHS professionals in relation to hazards.

5 Implications for the OHS Body of Knowledge

Partially to facilitate clarity of presentation, the hazard-specific chapters in the OHS Body of Knowledge have been organised on an energy-damage basis. 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.

Key thinkers

Haddon, Wigglesworth, Viner, Dekker

[7] See *OHS BoK* Risk.

References

CCOHS (Canadian Centre for Occupational Health and Safety. (2009). Hazard and risk [Electronic Version], *9th May 2011*, from www.ccohs.ca

Comcare. (2004). *Identify hazards in the workplace: A guide for hazards in the workplace* Canberra Commonwealth of Australia.

Dekker, S. (2011). *Drift into failure*. Surrey, England Ashgate Publishing Limited

ILO (International Labour Organisation). Building Safety, ILO Construction Training Package: Theme Summary 1 - Fundamental principles Retrieved July 7, 2011, from http://www.ilo.org/public/english/dialogue/sector/sectors/constr/download/theme-summaries/theme1.pdf

Macdonald, W. (2005). *A hierarchy of risk control measures for prevention of work-related musculoskeletal disorders* Paper presented at the International Ergonomics Conference on Humanising Work and the Work Environment Guwahati, India.

National Occupational Health and Safety Commission. (2004, 2004). Type of Occurrence Classification System. 3rd. Retrieved 29th July 2005, from http://www.nohsc.gov.au/PDF/Statistics/TOOCS3.pdf

Reason, J. (1997). *Managing the risks of organisational accidents* Aldershot: Ashgate Publishing Limited.

SA/SNZ (Standards Australia/Standards New Zealand). (2009). AS/NZS ISO 31000: Risk management - Principles and guidelines Sydney: Standards Australia.

Safework Australia. (2010). Code of practice: How to manage work health and safety risks (draft). Canberra

Standards Australia. (2001). AS/NZS 4801 Occupational health and safety management systems - Specification with guidance for use. Sydney: Standards Australia.

Standards Australia. (2004). *AS4360: Risk management* Sydney: Standards Australia.

Viner, D. (1991). *Accident analysis and risk control*. Melbourne VRJ Delphi.

Workplace Health and Safety Queensland. (2008). Risk Management Code of Practice 2007 Supplement 1 – Hazard identification. Brisbane Department of Justice and Attorney General, Queensland