

## The reasonably practicable test and work health and safety-related risk assessments

CHRISTOPHER PEACE\*

### Abstract

The test of “so far as is reasonably practicable” (SFAIRP) arose from the mid-1800s in English common law to determine if a duty of care for work health and safety had been met. It was arguably most famously summarised in the case of *Edwards v National Coal Board* 1949, but has since been used in the UK Health and Safety at Work Act that has, in turn, given rise to similar legislation in other jurisdictions. Internationally, the SFAIRP test has been the subject of many common law and criminal law cases to determine if all that could reasonably be done had, in fact, been done. However, a literature search carried out as part of wider research found no discussion of the implied requirement in the test that a risk assessment be carried out as part of demonstrating that SFAIRP requirements had been met. This has become of some significance in New Zealand and Australia due to the passage of recent legislation founded on SFAIRP.

This article addresses this gap and then reviews what a risk assessment might include. Risk assessment processes and techniques (derived from international standards) that might satisfy a regulatory agency or the courts are then outlined and their use in practice is indicated from the findings of an online survey and related field work. These findings suggest a knowledge or practice gap that may reduce the effectiveness and acceptability of risk assessments. Some options for closing that gap are described.

The paper concludes with a discussion of some of the implications of ineffective risk assessments for the courts, directors, employers and workers.

**Keywords:** risk assessment, international standards, work health and safety legislation, the reasonably practicable principle

### Background

Exploration of the effectiveness of risk assessments in informing decision makers identified implied legal requirements for risk assessments that might satisfy judicial and statutory interpretations of the “so far as is reasonably practicable” (SFAIRP) test in the common law duty of care and Robens-style work health and safety legislation. This research also found that company legislation in New Zealand and other jurisdictions allows directors to rely on

---

\* PhD student, School of Management, Victoria Business School Orouariki, Victoria University of Wellington, PO Box 600, Wellington 6140, New Zealand  
Principal Consultant, Risk Management Ltd, PO Box 7430, Wellington, 6242, New Zealand  
[chris.peace@riskmgmt.co.nz](mailto:chris.peace@riskmgmt.co.nz)

An early draft of this paper was presented at the Victoria University of Wellington Centre for Law, Employment and Work conference *The Changing Nature of Work and Employment*, on 28 and 29 November 2016.

professional or expert advice under specified circumstances, and (following recent legislation on work health and safety (WH&S) in Australia and New Zealand) that company officers and employers will need to consider whether they can rely on a risk assessment (Peace, Mabin, & Cordery, 2017).

Decisions from leading WH&S cases in three jurisdictions were reviewed and found to strongly imply the requirement for a risk assessment. However, no articles discussing such implied requirements were found in a literature search.

This paper responds to these issues as follows. It first briefly discusses the origins of the reasonably practicable test in the common law and recent New Zealand and Australian WH&S legislation. A selection of reported cases where the reasonably practicable test has been considered are then discussed, leading, it is argued, to the implied requirement for a risk assessment. The possible structure of such a risk assessment is then outlined before discussing how the best available information might be gathered, in theory and in practice, to demonstrate that a duty has been complied with *so far as is reasonably practicable*. The development and effectiveness of a novel tool for stakeholder engagement during risk assessments is described before concluding with implications for future research.

## **Origins of reasonably practicable and legislation**

In the early 1970s, the UK government recognised the need to rationalise work health and safety and related legislation, and regulatory agencies, and appointed a committee chaired by Lord Robens to review the law and make recommendations. The committee reported in 1972 and suggested that new legislation be based on the English common law duty of care (Lord Robens et al., 1972). That duty requires a duty-holder to discharge their duty “so far as is reasonably practicable”. The UK Health and Safety at Work Act (UK HSWA) became law in 1974 with cross-party support and has remained in place without any substantial amendment (Ford, 2002).

Since 1974, other countries have adopted the basic structure and duties of care in the UK legislation, including the SFAIRP test for compliance. In Australia, the government has sought to put in place a single, federal health and safety framework by developing a Model Bill (“Model Work Health and Safety Bill,” 2009) to replace sometimes conflicting Acts in each State.

After the New Zealand Pike River disaster (Macfie, 2013) the New Zealand government appointed a Royal Commission to enquire into the causes of the explosions and make recommendations (Royal Commission on the Pike River Coal Mine Tragedy, 2012). The Ministry of Business Innovation and Employment (MBIE) subsequently absorbed the regulatory functions of the Department of Labour (including the Mines Inspectorate). MBIE commissioned a report that determined regulatory work at the mine had fallen short of a good standard, so contributing to the disaster (Shanks & Meares, 2013).

The government also appointed a taskforce to investigate and report on improvements in the regulatory framework (Independent Taskforce on Workplace Health and Safety, 2013). The report recommended adoption of the Australian Model Bill, subsequently adapted to give a better fit with New Zealand law and practice (published as the “Health and Safety Reform Bill,” 2014). That Bill became law in April 2016 (renamed the “Health and Safety at Work

Act,” 2015 (NZ HSWA)) and sets out a series of duties of care modified by the SFAIRP test owed to workers and “other persons” who might be affected by workplace activities.

## **Reasonably practicable**

English common law decisions relating to workplace injuries and cases under the UK HSWA have often been cited in court in Australia and New Zealand. Some are outlined below before discussing relevant Australian and New Zealand cases.

### *UK case law*

In some cases, the meaning of the reasonably practicable test has been decided to imply a requirement for a risk assessment to be carried out before any harm occurred. The most significant and commonly cited case is *Edwards v National Coal Board (NCB)* (1949), and is reviewed first.

The facts of the case were that Mr Edwards (a colliery timberman) was going to his workplace along an underground travelling road in Marine Colliery, South Wales, a coal mine owned by the defendants, when he was killed by a fall of material from the side of the road. Although some propping and lining of the road had been carried out at places where weaknesses appeared, the point at which the accident occurred had no artificial support. The defendants contended that it was not reasonably practicable for them to have avoided or prevented the insecurity of the road at the point in question, there being nothing to indicate the existence of the latent defect, and that to require them to support all roads in the mine would be to impose on them an impossible financial burden.

Evidence from the original trial suggested that propping and lining the whole mine might be unreasonable in terms of cost but that it would be reasonable to either prop or prop and line the travelling roads and so make them safer. The court heard that “this particular travelling road which was only 400 yards long ... had, in fact, been timbered for about half its length and up to within 15 to 30 yards of the spot where this accident occurred.” Evidence was also heard that the necessary timbers were available at the surface of the mine. However, the mine officials seem never to have proactively considered the options of propping or propping and lining, although they did rely on a system of inspections and the “ordinary and usual precautions”.

Damages of £948 were awarded to Mr Edwards’ widow in the original trial and confirmed in the House of Lords appeal. “Reasonably practicable” was discussed in that appeal by Lord Asquith thus:

The onus was on the defendants to establish that it was not reasonably practicable for them to have prevented a breach ... “Reasonably practicable” is a narrower term than physically possible and it seems to me to imply that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and if it be shown that there is a gross disproportion between them – the risk being insignificant in relation to the sacrifice – the defendants discharge the onus on them. Moreover, this computation falls to be made by the owner at a point of time anterior to the accident. The questions [the

employer] has to answer are: (a) What measures are necessary and sufficient to prevent any breach ...? (b) Are these measures reasonably practicable? [Emphasis added.]

(Asquith LJ., in *Edwards -v- NCB* (1949))

The measures to prevent any breach suggest the need to assess the effectiveness of current controls and of options that might eliminate or minimise risk. The absence of evidence on which a conscious decision had been based was of importance to Lord Asquith who wrote:

I do not think any, or any sufficient, evidence was adduced as to the relative quantum of risk and sacrifice involved on the basis either that the mines as a whole (or that this particular roadway) should be taken as the unit – a necessary prerequisite to any decision that the defendants have proved the necessary measures impracticable.

In the same case Lord Tucker argued that:

This shows that in every case it is the risk that has to be weighed against the measures necessary to eliminate the risk. The greater the risk, no doubt, the less will be the weight to be given to the factor of cost (Tucker LJ., in *Edwards -v- NCB* (1949)).

Arguing that “a computation must be made” ... “at a point of time anterior to the accident” and “weighed” implies the need for a risk assessment that informs decisions about risk before harm has occurred. The “quantum of risk” relates to the harm that might be caused (death, injury or ill-health) and suggests the scale of the necessary risk assessment, perhaps including the questions suggested by Lord Asquith ((a) What measures are necessary and sufficient to prevent any breach ...? (b) Are these measures reasonably practicable?).

In a 1990 appeal under the UK HSWA, the need to take into account the likelihood of consequences was emphasised.

For the purpose of considering whether the defendant has discharged the onus which rests upon him to establish that it was not reasonably practicable for him, in the circumstances, to eliminate the relevant risk, there has to be taken into account (inter alia) the likelihood of that risk eventuating. The degree of likelihood is an important element in the equation. It follows that the effect is to bring into play foreseeability in the sense of likelihood of the incidence of the relevant risk, and that the likelihood of such risk eventuating has to be weighed against the means, including cost, necessary to eliminate it. [Emphasis added.]

(Goff LJ., in *Austin Rover Company v HM Inspector of Factories* (1990))

An earlier common law case distinguished between what is practicable and what is reasonably practicable thus:

The test of what is [reasonably practicable] is not simply what is practicable as a matter of engineering, but it depends on the consideration, in the light of the whole circumstances at the time of the accident and, whether the time, trouble and expense of the precautions suggested are or are not disproportionate to the risk involved, and also an assessment of the degree of security which of the measures suggested

may be expected to afford. [Emphasis added.]  
(Reid LJ., in *Marshall vs Gotham* (1954))

The phrase “in the light of the whole circumstances” again implies the need for a risk assessment while “an assessment ... of the measures” again pointed to the need to consider controls currently in place.

In a subsequent appeal, under UK HSWA, it was decided that “reasonably practicable” required a defendant to prove that:

... it was not practicable or not reasonably practicable to do more than was in fact done to satisfy the duty ... or that there was no better practicable means than was in fact used to satisfy the duty or requirement.  
(“*R v British Steel plc*,” 1994)

Reaching the conclusion that “there was no better practicable means” again requires some form of enquiry into current controls or options to eliminate or minimise risk – here, it is argued, a risk assessment.

#### *Australian case law*

The meaning of “reasonably practicable” in earlier Australian legislation was considered in a Supreme Court of Victoria case where it was determined that:

The Act does not require employers to ensure that accidents never happen. It requires them to take such steps as are practicable to provide and maintain a safe working environment.  
(Harper J., in *Holmes v RE Spence & Co Pty Ltd* (1992) at line 123)

Harper J considered this might done:

... by taking an active, imaginative and flexible approach to potential dangers in the knowledge that human frailty is an ever-present reality ... [so] ... preventing the human factor from resulting in injury.

This might require “no more than the making of a value judgement in the light of all the facts” based on “what was known at the relevant time” (Gaudron J., p. 53 in *Slivak v Lurgi (Australia) Pty Ltd* (2001) at page 53). This comment aligns with comments made by Tucker LJ in *Edwards v NCB* quoted above.

A grossly inadequate risk assessment carried out by an employer was found to have led to the death of a worker (Greenwood J., in *Comcare v John Holland Pty Ltd* (2016) at para 96). The court found that “no employee or agent of John Holland Pty Ltd undertook a formal risk assessment in relation” (emphasis added) to the planned work activity and that such a risk assessment ought to have addressed at least 20 practical questions about the conduct of the activity. The judgement again followed *Edwards v NCB* 1949 in that a risk assessment should have preceded the fatality.

In a 2016 case involving high-risk movement of vehicles in confined spaces the judge held that: ... so far as is reasonably practicable must involve the creation of strict, rigorous and comprehensive standards which are the religiously maintained.

(Cannon J, in *Director of Public Prosecutions V Toll Transport Pty Ltd* (2016))

Flores-Walsh, Costa, & Lo (2017) commented that this required:

... employers and other persons who conduct businesses and undertakings [to] ... identify ... the competence of their risk assessment processes and the persons who conduct assessments ...

### *New Zealand case law*

The reasonably practicable test formed part of the definition of “all practicable steps” in section 2A of the Health and Safety in Employment Act 1992, now repealed by NZ HSWA. In an appeal by the employer against conviction, the High Court seems to have followed the UK case *R v British Steel plc* (ibid), and found that the appellant had done what was practicable by carrying out an informal risk assessment (Hansen J, in *Buchanan’s Foundry Ltd v Department of Labour* (1996)). That enquiry should be “judged on the basis of what had been known at the relevant time”.

In a more recent case, the High Court found that use of a cherry picker was a practicable step and that the cost of hire (\$480) was reasonable when the lives of workers working at heights were at risk (Venning J, in *Martin Simmons Air Conditioning Services Ltd v Department of Labour* (2008)). However, use of a cherry picker had not been considered as part of any risk assessment.

The Australian case *Director of Public Prosecutions V Toll Transport Pty* (ibid) was echoed in a 2016 New Zealand case which found that policies and procedures identified as necessary as a result of a risk assessment should be maintained and subject to review (Rowe, J in *WorkSafe NZ v Rentokil Initial Ltd* (2016)).

### *Summary*

In summary, these cases from the UK, Australia and New Zealand strongly suggest that a decision about a WH&S-related risk must be preceded by a risk assessment that provides the best available information for that decision. This will enable a duty-holder to demonstrate it had done what was reasonably practicable and was using that information to enable monitoring of the risk for any changes in the work environment, work or workers.

## **Reasonably practicable in the NZ HSWA and the Model Bill**

Whereas judges have previously interpreted reasonably practicable in either the common law or statute law, the Model Bill and NZ HSWA set out the following definition.

### **22. Reasonably practicable**

In this Act, unless the context otherwise requires, reasonably practicable, in relation to a duty of a PCBU set out in subpart 2 of Part 2, means that which is, or was, at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters, including:

- (a) the likelihood of the hazard or the risk concerned occurring; and

- (b) the degree of harm that might result from the hazard or risk; and
- (c) what the person concerned knows, or ought reasonably to know, about:
  - (i) the hazard or risk; and
  - (ii) ways of eliminating or minimising the risk; and
- (d) the availability and suitability of ways to eliminate or minimise the risk; and
- (e) after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

The legislation introduced the term “person having control of a business or undertaking”, abbreviated in the Act as PCBU, defined as a natural person or other entity having control of a workplace.

Specific mention of “or ought reasonably to know” in clause (c) raises the question: “What does a duty-holder have to do to discover what they ought reasonably to know?”, an issue addressed later.

Guidance on reasonably practicable published by WorkSafe NZ (2016), the New Zealand regulator, states that many risks might be eliminated or minimised by the use of common controls, perhaps without the need for a full risk assessment. The guidance suggests that “if there isn’t a common control for a risk then you first need to evaluate the risk and the ways to control it. Then, lastly, you would consider the costs and if they are proportionate to the risk”. WorkSafe suggests such an evaluation – a risk assessment – might include:

- how likely is the risk to occur
- how severe is the harm that might result from the risk
- what you know or ought reasonably to know about the risk and the ways of eliminating or minimising it
- the availability of the control measures, and how suitable they are for the specific risk.

The guidance then suggests “as a final step, consider if the cost of setting up control measures is grossly disproportionate to the risk” and that “cost is rarely an excuse for not setting up a necessary control for a risk”. Although this guidance is for small to medium businesses, it makes no reference to how a risk assessment might be carried out (eg, a suitable process or suitable techniques) or form part of related workplace activities (eg, quality improvement), and how a simple cost benefit analysis might be conducted.

The factors to be considered when assessing if a WH&S-related risk has been minimised, SFAIRP have also been described by WorkSafe NZ (2016) and the UK regulator, the Health and Safety Executive (HSE, 2001), and are summarised in Table 1, structured to match the requirements of section 22 NZ HSWA (clause 18 of the Model Bill), and section 137 of the NZ Companies Act 1993.

**Table 1. Summary of factors affecting demonstration of SFAIRP**

Sources: WorkSafe NZ (2016); HSE (1992; 2001); section 22 NZ HSWA; Lowrance (1976)

Factor	Issues to consider
(a) likelihood of the hazard (cause) or risk occurring	What is the current state of knowledge about the likelihood of harm? Is the likelihood continuous (chronic) or sudden (acute)? Are there uncertainties about the likelihood of the harm?
(b) the degree of harm (the consequences) that might result from the hazard or risk	What would be the nature and severity of the potential harm? What is known about harm of that nature and severity? Will harm be immediate or delayed Is there a possibility of harm to future generations? Is the harm reversible? Are there uncertainties about the magnitude of the harm? What are the expected number and range of harms arising from the hazard? Is the harm common or dread (ie, deeply feared by some people)? Would there be no detectable adverse effect? Are vulnerable groups of the public exposed?
(c) What is known about: (i) the hazard or risk  (ii) ways of eliminating or minimising the hazard or risk	What is the current state of knowledge about the means available to eliminate or minimise the risk? Are guidance documents on the hazard and associated risks freely available or of restricted-access? Is the hazard natural or man-made? What is the exposure relative to natural background? Is the hazard occupational or non-occupational or both? Are the people exposed to the hazard aware of it and any potential harm it might cause (ie, voluntary or involuntary)? Is the hazard familiar or novel? What could reasonably be done to discover new means to eliminate or minimise the risk? Can the hazard (causes of risk) or potential harm (consequences) be eliminated? Can a lesser hazard be substituted for the current hazard, so reducing the risk? Can the hazard be isolated from people? Can people be isolated from the hazard? Can an engineering control be used to minimise the hazard? Can administrative controls be implemented to minimise the risk? If there is still a risk, would personal protective equipment be of any benefit?
(d) the availability and suitability of ways to eliminate or minimise the risk	Arising from (c)(ii): What are the current controls over the risk? What is the effectiveness of those controls? Who manages the controls? Do workers and/or the public have confidence in the quality of that management? Could emergency services cope with any incidents?
(e) the cost, including whether the cost is grossly disproportionate	Could relatively cheap expenditure or modifications significantly reduce risk?



to the risk	See further discussion on “grossly disproportionate” below
NZ Companies Act 1993, section 138 and NZ HSWA, section 44	Do workers and/or the public have confidence in the independence and quality of expert advice? How is the risk viewed in light of prevailing professional practice?

### Risk assessments

The meaning of risk ought to be the starting point for discussion of how a risk assessment might be conducted or how that a risk assessment might be a driver for change in a process or business activity. Conversely, the “grossly disproportionate” part of reasonably practicable has often been discussed (including Ale, Hartford, & Slater, 2015; Aven & Abrahamsen, 2007; Fischhoff, Lichtenstein, Slovic, Derby, & Keeny, 1981; Jones-Lee & Aven, 2011; Lowrance, 1976; Thomas & Vaughan), but mostly as a standalone topic, unrelated to the meaning of risk or the outcome of a risk assessment. Some authors draw on the “value of a prevented fatality” (VPF) or “value of a statistical life” (VOSL) as a source of data for the application of techniques such as cost benefit analysis, cost effectiveness analysis or multi-attribute utility theory.

The Model Bill and NZ HSWA do not define “risk” and so, for the purposes of this paper, the definition in the international standard, ISO31000: 2009 *Risk management: principles and guidelines*<sup>1</sup>, is used. This standard (and most other management standards published by the International Standards Organization) define risk as the “effect of uncertainty on objectives”, suggesting that any risk assessment must start with an understanding of organisational objectives, including those for work health and safety, and then analyse the effects of uncertainty on those objectives.

A range of standards and documents gives guidance on risk assessments but may be sector- or activity-specific, whereas ISO31000 states it can be applied to any risk in any organisation. Managers and others can, therefore, use this generic standard and its definitions to help manage risk, regardless of the consequences. This view was confirmed by Safe Work Australia (a Federal agency established to coordinate and develop national policy and strategies) in a guide that suggests the process for deciding what is reasonably practicable “is consistent with guidance on risk management” (Safe Work Australia, 2011).

The causes and effects of uncertainty can then be assessed, leading to an understanding of the risk, how effectively it is currently managed, whether it is currently acceptable and, if not acceptable, identification of options for elimination or minimisation of the risk.

Risk assessment is defined in ISO31000 as the “overall process of risk identification, risk analysis and risk evaluation” and risk assessment is part of the overall risk management process – how an organisation increases the certainty that its objectives will be achieved. To provide the best available information for a decision about risk (ISO, 2009, p. 7, principle f) a risk assessment should follow a structured process to identify and analyse possible causes of events, their consequences, the likelihood of those consequences and the effectiveness of current controls.

Once in possession of the best available information, a decision maker must then address the “acceptable risk problem” (Fischhoff et al., 1981) to decide if a WH&S-related risk is

<sup>1</sup> (published in Australia and New Zealand as AS/NZS ISO31000: 2009

acceptable, tolerable or intolerable. That is: “Has this risk been minimised so far as is reasonably practicable?” as per *Edwards v NCB* 1949 and section 22, HSWA (section 18, Model Bill).

Based on this ISO31000 definition and approach, risk assessments can be seen as a “precautionary” management activity that should be “game-changing” information technology (Goble & Bier, 2013), capable of informing decisions, engendering stakeholder trust in decisions, and facilitating adaptation and experimentation by decision makers and risk managers. Risk assessments should contribute to management as a technology and help discover and contextualise knowledge in an understandable representation, communicated by a credible person, that aids rational decisions (Bloom, Raffaella, & Van Reenen, 2016). Issues associated with whether the cost of a possible control is “grossly disproportionate” may then be of less significance.

The statutory definition of reasonably practicable and WorkSafe NZ guidance includes “what the person concerned knows, or ought reasonably to know ...”. It is argued that following the above approach will help respond to this requirement, but without a formal process and use of relevant risk techniques may miss key aspects of uncertainty.

### ***What might be included in a “reasonably practicable” risk assessment?***

If a risk has both low uncertainty and low complexity, a simple screening risk assessment may be sufficient to show that relevant codes of practice or other well-established and applicable guidance will either eliminate or minimise the risk (HSE, 2001; WorkSafe NZ, 2016). However, in assessments of more complex risks with WH&S-related consequences, a more detailed risk assessment may be necessary to help answer the “acceptable risk problem”.

Fischhoff et al. (1981) concluded the “acceptable risk problem” was hard to resolve due to difficulties in agreeing on terms of reference for risk assessments, distinguishing facts and values, and difficulties with professional judgement. Such difficulties have been partly addressed by ISO31000 (ibid), supported by IEC/ISO31010 (2009) *Risk assessment techniques*<sup>2</sup> and a range of technique-specific International Electrotechnical Commission (IEC) standards. Several authors have also addressed the conduct of risk assessments, and how to avoid failures of risk assessments (Busby & Hughes, 2006; Haas, 2016; Wiedemann et al., 2013).

## **Techniques for use in the risk assessment process**

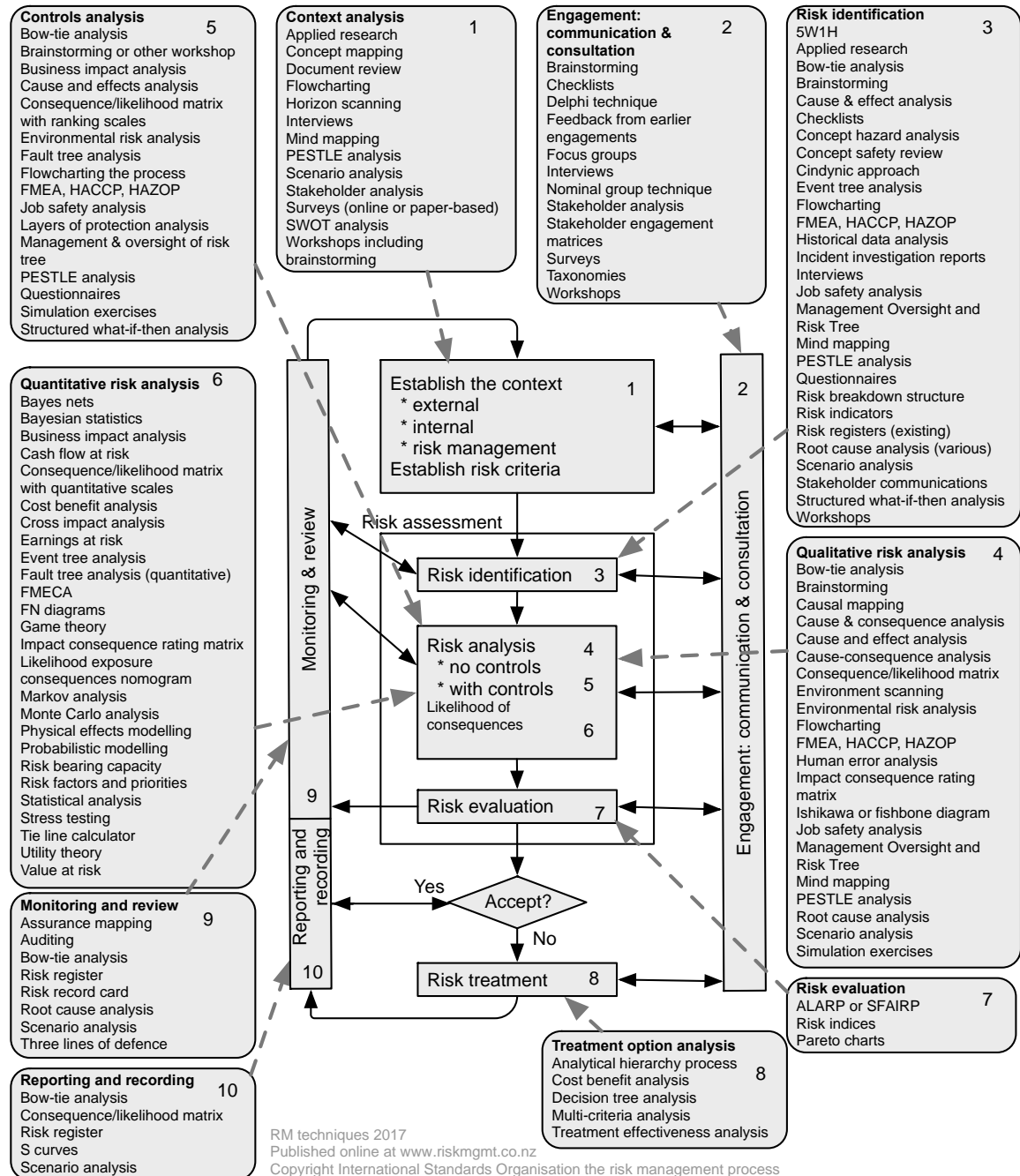
Research into the effectiveness of risk assessments is continuing, including examination of which risk assessment techniques might be used to help identify and analyse uncertainty, its effect on objectives and to enable evaluation of analysed risks against the reasonably practicable test. The techniques thought to be most commonly used were mapped against an amended version of the risk management process in ISO31000 (see Figure 1) and their use tested in an online survey.

---

<sup>2</sup> Published in Australia and New Zealand as SA/NZS HB89:2013 Risk management – Guidelines on risk assessment techniques

**Figure 1. Risk assessment techniques in the selected process**

This graphic is based on the ISO 31000 risk management process diagram. Possible risk techniques are shown in boxes with solid lines and curved corners to indicate where they might be used. Note that some techniques can be used in several stages of the process.



RM techniques 2017  
 Published online at [www.riskmgmt.co.nz](http://www.riskmgmt.co.nz)  
 Copyright International Standards Organisation the risk management process  
 Copyright Risk Management Ltd 207-2017 for mapping techniques against the process

The numbered boxes in the diagram represent the sequence in which each stage might be carried out. Note that box 7 (bottom right corner) includes “so far as is reasonably practicable” and the abbreviation ALARP (“as low as is reasonably practicable”) to help ensure that UK respondents recognised it.

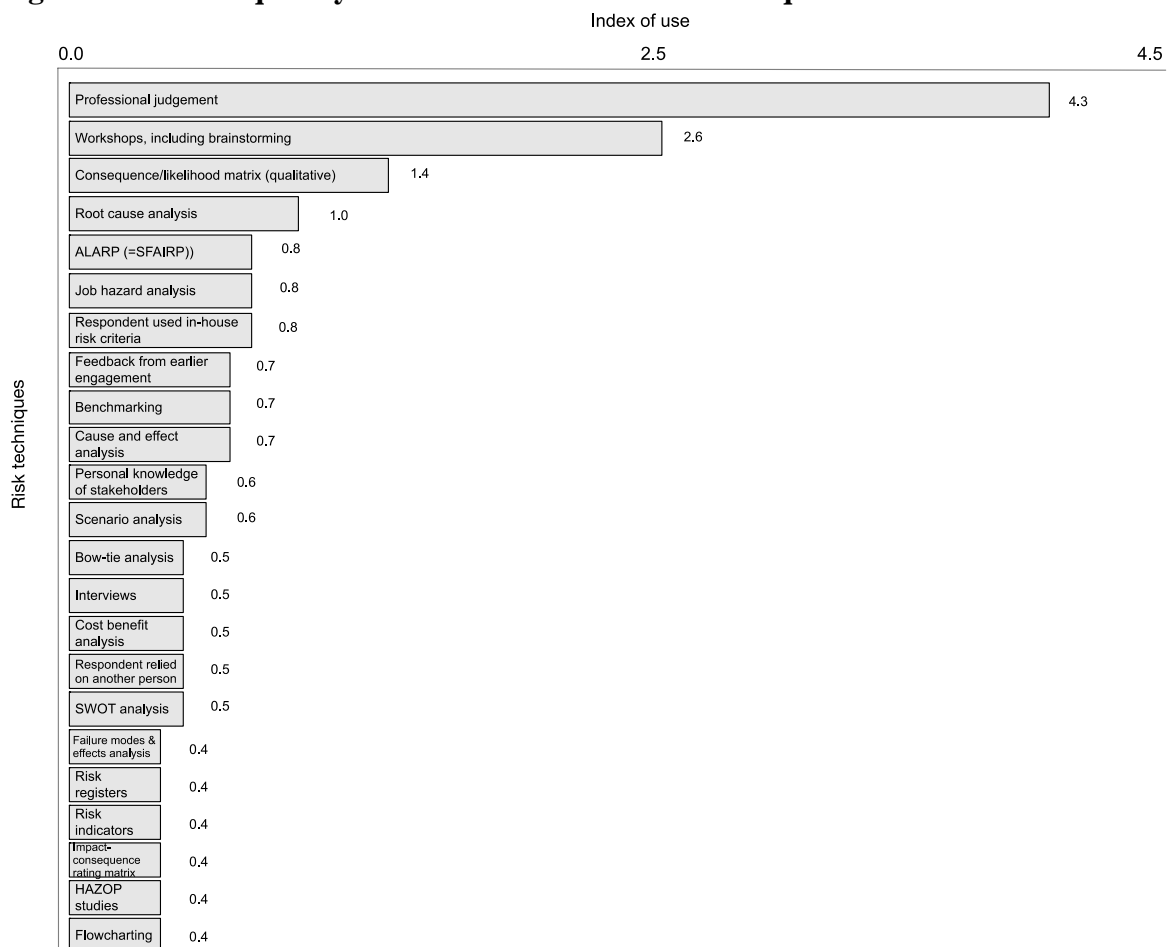
Before release of the survey, it was pre-tested with focus groups of risk practitioners and amended to include techniques that had been overlooked, resulting in inclusion of “professional judgement” in the survey (but not in Figure 1).

**Survey results**

To summarise the range of techniques used by respondents, an index for each technique was calculated by dividing the number of selections for each risk technique by the total number of respondents to each question. The 23 highest-ranked techniques are listed in descending order in Figure 2, showing that the techniques most frequently selected were:

- professional judgement
- workshops, including brainstorming
- consequence/likelihood matrix with ranking scales.

**Figure 2. Most frequently selected risk assessment techniques**



More structured techniques had low scores, suggesting that many risk and safety practitioners preferred to use their professional judgement or, perhaps, were not aware of those techniques. If the same is true for managers, this may be an explanation for the failure of risk assessments that might have been intended to demonstrate that WH&S-risk had been minimised “so far as is reasonably practicable” (Gadd, Keeley, & Balmforth, 2003; Stulz, 2009). The survey results (and the preceding focus groups) showed that cost benefit analysis and multi-attribute utility theory were rarely or never mentioned by respondents as techniques to aid decisions about the cost of risk treatment and whether it might be “grossly disproportionate to the risk”.

Many of the techniques are at least superficially the same or closely related. For example, bow-tie analysis is based on fault tree analysis and event tree analysis and strongly resembles cause and effect analysis (which does not identify an event), while root cause analysis (IEC, 2015) is a collection of techniques that can include fault tree analysis.

The research, therefore, suggests that risk assessors most often use their professional judgement, regardless of any apparent need for a structured approach to demonstrate that reasonably practicable steps have been taken to assess and then manage risk. This may be because they are not aware of generally accepted processes or relevant techniques that can help provide the best available information about uncertainty in risk. Risk assessments using professional judgement therefore may suffer from bias (Kahneman, Rosenfield, Gandhi, & Blaser, 2016; Montibeller & von Winterfeldt, 2015).

## **Can risk assessments be improved?**

In research to date, two options for improving risk assessments have been considered.

### ***Graphically relating techniques to process***

Some practitioners may be aware of IEC/ISO31010 but not relate the techniques it describes to the different stages in the risk management process. **Error! Reference source not found.** was initially developed to aid development of the online survey but may also help practitioners to select techniques that are relevant to their risk assessment needs and practice.

### ***Graphical elicitation methods – flipcharts, Post-it notes and the risk canvas***

Graphical methods including flowcharts, maps, charts, diagrams and visual metaphors can be used to help elicit risk information (Bagnoli, 2009; Crilly, Blackwell, & Clarkson, 2006; Eppler & Aeschimann, 2009). Training courses for managers and risk and safety practitioners by the author had used flipcharts and Post-it notes as a way of using some risk techniques, but failed to deliver consistent or reproducible results. When a series of one-day training courses was run in 2015, contacts in the organisation suggested (M.Ward & G.Burnett, personal communication, 27 July 2015) that a large sheet of paper be used, pre-printed with the risk techniques being taught, instead of “free-form” flipcharts and Post-it notes. This was named the “Risk Canvas” and has since been developed to aid the application of selected risk techniques from IEC/ISO31010, within the ISO31000 risk management process. These include stakeholder analysis, document review, PESTLE

analysis, SWOT analysis, bow-tie analysis, and rating scales for risk velocity, controls effectiveness and probability.

Anecdotal evidence suggested the first versions worked well and it has been developed to version 2.3 (available at <http://www.riskmgmt.co.nz/publications/>), setting out information to further aid engagement with stakeholders and application of techniques. Victoria University Human Ethics Committee approval, therefore, was sought and granted to seek anonymous feedback on the risk canvas in training courses and other settings. Use of the risk canvas will be reported when more data has been gathered but, to date, the overwhelming response has been in favour of its use during training courses and, potentially, in real-world risk assessment workshops.

In three training courses, attendees were also asked to estimate the level of risk (extreme, high, medium, low or negligible) in a case study before and after using the risk canvas. Preliminary analysis of the limited data suggests that use of the risk canvas may result in about a 25 per cent reduction in variability of the estimated level of risk; this will be further investigated.

The risk canvas also enables linking with other techniques (including flowcharting, HAZOP, FMEA and HACCP) in workshops and will be developed to enable use of these and other techniques. The risk canvas is, therefore, a means to aid discovery of “what the person concerned knows, or ought reasonably to know” about a WH&S-related risk and so discharge the implied “reasonably practicable” requirement for a risk assessment

## **Implications for practice**

If managers and safety or risk practitioners prefer to use professional judgement rather than structured techniques they may be in breach of the implied requirement of “reasonably practicable” to carry out a risk assessment before a worker or other person has been harmed. Further, a short, recent article (Lloyd & Healy, 2017) indicates that safety and risk practitioners who fail to conduct an effective risk assessment could be in breach of the NZ HSWA (or, in Australia, the Model Bill). This corroborates the earlier comments by Costa, & Lo (2017) about risk assessments and risk assessors.

As noted, the implied requirement for a risk assessment, supported by guidance from regulators, necessitates understanding the level of uncertainty about achieving organisational, statutory and common law WH&S objectives, and should include the:

- degree of harm that might be caused (death, injury or ill health)
- likelihood of that harm
- controls already in place
- further options to eliminate or minimise the risk
- costs of the options to eliminate or minimise the risk and whether those costs are grossly disproportionate.

The lack of structure inherent in professional judgement may also result in failure to gather the best available information to help decide if a WH&S-related risk has been eliminated or minimised, so far as is reasonably practicable. Use of the risk canvas has been found to

provide a structured approach that engages workshop participants and helps overcome biases.

Management training courses may not always include how to carry out a risk assessment. In New Zealand, some 98 per cent of businesses are small or medium sized enterprises (SMEs) whose managers may not have undergone formal safety training, an issue complicating risk management that has been identified internationally by many authors including:

- Bluff (2005), who discussed at length the need for specialist support for small- or medium-sized businesses in Australia if they were to achieve compliance with occupational health and safety legislation
- Champoux and Brun (2015), who found that occupational health and safety in SMEs was not well managed in Quebec
- Deighan, Lansdown, & Brotherton (2009), who found a low level of occupational health and safety activity in a sample of UK SMEs
- Legg et al. (2010), who found a low level of integration of occupational health and safety in business systems in New Zealand SMEs.

This issue may also extend to safety and risk practitioners; an unpublished online survey of 1,438 safety practitioners in early 2016 had a 27 per cent response rate and suggested a general lack of training in risk assessment practice in New Zealand safety practitioners (Peace, 2016).

## **Implications for future research**

This paper suggests the following areas for future research.

- Analysis of court cases under the now-repealed NZ Health and Safety in Employment Act 1992 and the HSWA to try to identify the quality and frequency of risk assessments before the harm that led to a prosecution.
- In-depth analysis of the effectiveness and benefits of the risk canvas other than during training courses. This might be done by the researcher observing, but not intervening in, use of the risk canvas.
- Investigation into professional judgement in risk assessments, as applied by line managers and safety practitioners in New Zealand, to help identify knowledge and practice gaps.

## **Contributions of this research**

This research made the following contributions.

- The requirement for a risk assessment, implied in section 22 NZ HSWA, the Model Bill and leading cases, has been identified, explored and made explicit for use of other researchers and for practitioners.
- The content of a risk assessment has been explored using relevant NZ and UK guidance.
- The high level of use of professional judgement by safety and risk practitioners in risk assessments has been quantified.
- Two options to help improve the practice of risk assessments have been developed and one has been tested in the field, showing it may be worth pursuing.

### **Acknowledgement**

The helpful comments of an anonymous reviewer are gratefully acknowledged.

### **Cases cited**

Austin Rover Group Ltd v HM Inspector of Factories (1990), 1 AC 619 1;  
Buchanans Foundry Ltd v Department of Labour (1996), NZLR 112;  
Comcare v John Holland Pty Ltd (2016), Federal Court of Australia, 501  
DPP V Toll Transport Pty Ltd (2016), County Court of Victoria, VCC 1975; CR-16-01137  
Edwards -v- NCB (1949), Kings Bench, All ER 743 1  
Haas, C. N. (2016). Reproducible Risk Assessment. *Risk Analysis*, 36(10), 1829-1833.  
Holmes v RE Spence & Co Pty Ltd (1992), Supreme Court, VIR 119 (VSC);  
Marshall vs Gotham Co Ltd (1954), House of Lords, All ER 937 AC360;  
Martin Simmons Air Conditioning Services Ltd v Department of Labour (2008), High  
Court, Auckland, CRI 2007-404-249 777;  
R v British Steel plc (1994), CACD 31 Dec 1994  
Slivak v Lurgi (Australia) Pty Ltd (2001), High Court of Australia, Commonwealth Law  
Reports  
WorkSafe NZ v Rentokil Initial Limited (2016), District Court,

### **References**

- Ale, B.J.M., Hartford, D.N.D., & Slater, D. (2015). ALARP and CBA all in the same game. *Safety Science*, 76(July): 90-100.
- Aven, T., & Abrahamsen, E.B. (2007). On the Use of Cost-Benefit Analysis in ALARP Processes. *International Journal of Performability Engineering*, 3(3): 345-353.
- Bagnoli, A. (2009). Beyond the standard interview: the use of graphic elicitation and arts-based methods. *Qualitative Research*, 9(5): 547-570.
- Bloom, N., Raffaella, S., & Van Reenen, J. (2016). *Management as a technology?* (Working Paper 22327). Cambridge, MA: National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w22327>
- Bluff, E. (2005). *The missing link – regulating occupational health and safety support*. (Working Paper 35) Canberra: Australian National University
- Busby, J., & Hughes, E. (2006). Credibility in risk assessment: a normative approach. *International Journal of Risk Assessment and Management*, 6(4/5/6): 508-527.
- Champoux, D., & Brun, J.-P. (2015). OSH practices and interventions in small businesses: global issues in the Québec context. *Policy and Practice in Health and Safety*, 13(1): 47-64.
- Costa, M., & Lo, M. (2017). ‘A tragedy waiting to happen’: record OHS fine confirms why risk assessments are key. Retrieved from <http://www.corrs.com.au/publications/corrs-in-brief/a-tragedy-waiting-to-happen-record-ohs-fine-confirms-why-risk-assessments-are-key/>



Crilly, N., Blackwell, A.F., & Clarkson, P.J. (2006). Graphic elicitation: using research diagrams as interview stimuli. *Qualitative Research*, 6(3): 341-366.

Deighan, C., Lansdown, T. C., & Brotherton, C. (2009). Using 'stage of change' and 'business activity models' to assess and improve health and safety behaviours in SMEs. *Policy and practice in health and safety*, 7(1): 69-83.

Eppler, M.J., & Aeschmann, M. (2009). A systematic framework for risk visualization in risk management and communication. *Risk Management: an international journal*, 11(2): 67-89.

Fischhoff, B., Lichtenstein, S., Slovic, P., Derby, S.L., & Keeney, R.L. (1981). *Acceptable Risk*. Cambridge: Cambridge University Press

Ford, M (ed.). (2002). *Redgrave's Health and Safety* (4th ed.). London: Butterworths LexisNexis.

Gadd, S., Keeley, D., & Balmforth, H. (2003). *Good practice and pitfalls in risk assessment*. Research Report RR 151 for Health and Safety Executive; Sudbury: HSE Books

Goble, R., & Bier, V. M. (2013). Risk assessment can be a game-changing information technology—but too often it isn't. *Risk Analysis*, 33(11): 1942-1951.

HSE (Health and Safety Executive). (1992). *The Tolerability Of Risk From Nuclear Power Stations*. Retrieved from <http://www.onr.org.uk/documents/tolerability.pdf>

HSE (Health and Safety Executive). (2001). *Reducing risks, protecting people*. Retrieved from <http://www.hse.gov.uk/risk/theory/r2p2.pdf>

IEC 62740:2015 (2015). *Root cause analysis (RCA)*. Retrieved from <https://webstore.iec.ch/publication/21810>

Independent Taskforce on Workplace Health and Safety. (2013). *The Report of the Independent Taskforce on Workplace Health & Safety He Korowai Whakaruruhau*. Retrieved from <http://hstaskforce.govt.nz/documents/report-of-the-independent-taskforce-on-workplace-health-safety.pdf>

Jones-Lee, M., & Aven, T. (2011). ALARP – What does it really mean? *Reliability Engineering & System Safety*, 96(8): 877-882.

Kahneman, D., Rosenfield, A.M., Gandhi, L., & Blaser, T.O.M. (2016). NOISE: How to overcome the high, hidden cost of inconsistent decision making. *Harvard Business Review*, 94(10): 38-46.

Legg, S., Olsen, K., Harris, L., Laird, I., Massey, C., Battisti, M., Lamm, F., & Hasle, P. (2010). Understanding the programme theories underlying national strategies to improve the working environment in small businesses. *Policy and Practice in Health and Safety*, 8(2): 5-35.

Lloyd, A., & Healy, N. (2017). Consultants at risk. *Safeguard* 162, pp. 8

Lord Robens, A., Beeby, G., Pike, M., et al. (1972). *Safety and Health at Work: Report of the Committee, 1970-72*. London: HMSO.

Lowrance, W. (1976). *Of Acceptable Risk: Science and the Determination of Safety*. New York: Harvard University.

Macfie, R. (2013). *Tragedy at Pike River mine: how and why 29 men died*. Wellington: Awa Press.

Montibeller, G., & von Winterfeldt, D. (2015). Cognitive and Motivational Biases in Decision and Risk Analysis. *Risk Analysis*, 35(7): 1230-1251.

Peace, C. (2016). *Professional development survey: analysis of results and suggestions*. (Client Report CR 0153 for New Zealand Institute of Safety Management) Wellington: Risk Management Ltd. Retrieved from <http://www.riskmgmt.co.nz/publications>

Peace, C., Mabin, V., & Cordery, C. (2017). Due diligence: a panacea for health and safety risk governance? *Policy and Practice in Health and Safety, on-line edition*, 1-19.

Royal Commission on the Pike River Coal Mine Tragedy. (2012). *Royal Commission on the Pike River Coal Mine Tragedy, Volume 1*. Retrieved from [http://pikeriver.royalcommission.govt.nz/vwluResources/Final-Report-Volume-One/\\$file/ReportVol1-whole.pdf](http://pikeriver.royalcommission.govt.nz/vwluResources/Final-Report-Volume-One/$file/ReportVol1-whole.pdf)

Safe Work Australia. (2011). *Interpretive guideline – model work Health and Safety Act: the meaning of ‘reasonably practicable’*. Guidance Note: Author.

Shanks, D., & Meares, J. (2013). *Pike River Tragedy*. Investigation Wellington: Ministry of Business, Innovation and Employment. Retrieved from <http://www.mbie.govt.nz>

Stulz, R. M. (2009). 6 Ways Companies Mismanage Risk. *Harvard Business Review*, 87(3): 86-94.

Thomas, P. J., & Vaughan, G. J. Testing the validity of the “value of a prevented fatality” (VPF) used to assess UK safety measures. *Process Safety and Environmental Protection*, 94, 239-261.

Wiedemann, P., Boerner, F., Dürrenberger, G., Esternberg, J., Kandel, S., van Rogen, E., & Vogel, E. (2013). Supporting non-experts in judging the credibility of risk assessments (CORA). *Science of The Total Environment*, 463–464: 624-630.

WorkSafe NZ. (2016). *Reasonably Practicable*. Fact Sheet WSNZ\_2191\_Mar 16 Wellington: Author. Retrieved from <http://www.worksafe.govt.nz>