

A New Version of the Hierarchy of Risk Controls

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A new version of the traditional **Hierarchy of Risk Control HoRC** [Fig 1] has been developed, and has been critiqued by over 500 world-wide HSE commentators on Linked-In. A number of versions have been defined in HSE laws and regulations in many countries. This version allows assurance that all criteria as well as legal obligations are being complied with, and adequately considered when choosing risk controls to manage risk levels effectively.

The choice of risk control options – optioneering – is a critical stage of the Risk Management process as prioritisation of choices needs to be based on consideration of the range of variation of the four not-completely independent criteria Table 1 and shown as increasing / decreasing arrows in Fig 1.

Hierarchy Priority Criteria	Alternative Terminology for Risk Treatments
1. Legal / Regulatory Priority 2. Human Factors / Reliability 3. Effectiveness 4. Cost / Benefit	Risk Controls, Avoidance, Sharing, Barriers, Defences, Safeguards, Mitigation Factors, Safety Measures, Safety Devices, Layers of Protection, Protection Measures

Table 1 Criteria / Attributes of the HoRC

During the risk evaluation and subsequent risk treatment phases of the Standard RM Risk Management process [Fig 2], the new HoRC design described here allows all users to quickly and effectively choose preferred options for any new, additional or changed risk controls.

Hierarchy of Risk Controls HoRC

TYPES		EXAMPLES	OHS&E Legal Priority	Reliance on Humans	Normally Effective	Apparent \$ Cost
HARD	Physical Engineering Controls	Removal / elimination / substitution / design / interlocks / valves / cut-outs / fuses / interrupters / separation / guards / barriers / limiters / ergonomic redesign / Software Controls / Fail-Safe position hold & return to home	First	Low	More	More
	Administrative Controls	Rules / Work Practices / Manuals / Policies & Procedures / Checklists/ Permits To Work (PTW) / Exclusion Zones / Work Rosters	↓	↓	↑	↑
	Supervision / Enforcement	Selection and preparation of personnel / behaviour change methods / Fair & Just discipline / Counselling / Culture				
	Checking / Assessments	Audits / Inspections / reviews / risk assessments / JRAs job risk assessments / frequency / depth / independence				
Behavioural Controls	Training / Wearing PPE / Using lockouts / tags / Heeding warnings / alarms / signs / interactions / observations / Risk Based Conversations / Counselling / Fair & Just Discipline					
SOFT			Last	High	Less	Less

1. HoRC needs to be used during risk identification as well as during risk treatment / control
2. Ultimately ALL controls rely on humans – designers, makers, installers, users, maintainers, supervisors, managers, etc..
3. Always have multiple controls – to lower the likelihood of all not working or missing at the same time
4. Always use a complementary mix of HARD & SOFT controls – e.g. a machine guard still needs to be checked / inspected
OR a rule always requires related knowledge, skill, supervision, effective & efficient design of required tools equipment methods
5. Always support reactive C controls that only reduce/mitigate Consequence–rescue, first aid, fire fighting with proactive L controls

Fig 1 New Version of the Hierarchy of Risk Control HoRC

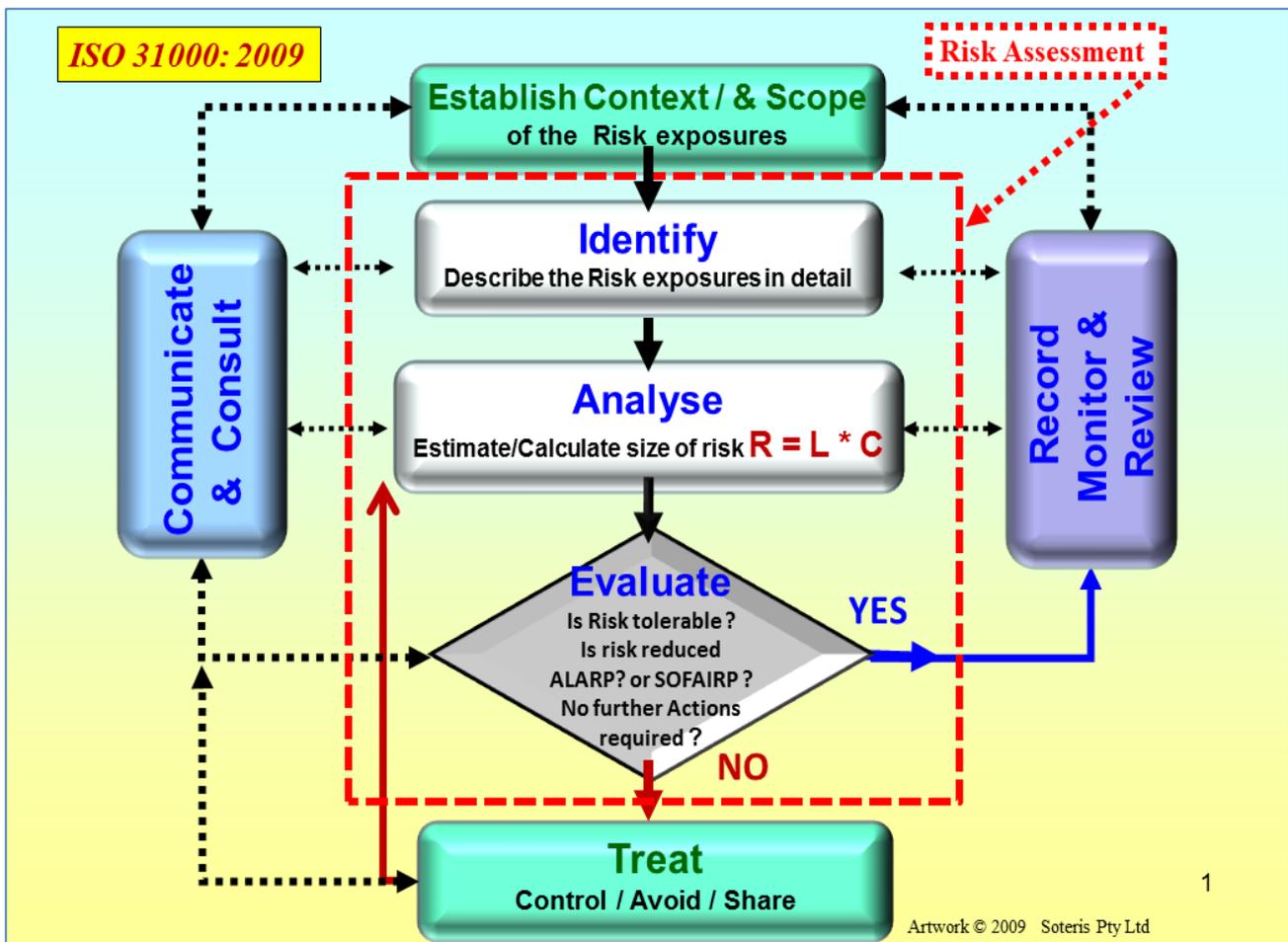


Fig 2 Risk Management Process [adapted from ISO 31000:18]

1. Legal / Regulatory Priority

The moral, logical & legal criterion – i.e. the requirement for the risk level to be managed SOFAIRP - So Far As Is Reasonably Practicable or to ALARP – As Low As Reasonably Practicable - is the ultimate arbiter of choice. It overrides all other criteria when applying the HoRC. The ALARP principle essentially defines what is “safe enough”.

Reasonably Practicable RP is a fundamental principle of legal compliance, due diligence and duty of care that needs to be defined as objectively as possible. [Table 2]

What is reasonably practicable in ensuring health and safety

*In this Act, **reasonably practicable**, in relation to a duty to ensure health and safety, 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 the risk; and*
- (c) *what the person concerned **knows, or ought reasonably to know**, about -*
 - (i) *the hazard or the 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**.*

Anon 2011 QLD Work Health and Safety Act 2011 Part 2 Health and Safety Duties

Table 2 Example of a Formal Definition of the Legal Tenet of “Reasonably Practicable”

RP is a legal risk tolerability criterion and a threshold of negligence. An example of its definition was summarised by an Australian High Court judgment of 1982 by Chief Justice Gibbs which describes it as follows :-

"Where it is possible to guard against a foreseeable risk, which, though perhaps not great, nevertheless cannot be called remote or fanciful, by adopting a means, which involves little difficulty or expense, the failure to adopt such means will in general be negligent.

That is, it does not matter how low the risk estimate is, if more can be done for very little effort, then the failure to do so will be negligent, in the event of an incident."

In brief, ALARP requires evidence that can demonstrate that all reasonable measures to manage a risk are being implemented. Evidence is also necessary to show that new or different or changed risk control measures continue to be implemented when risk factors change, as they always do. Most risk control can become ineffective or even absent because of ever-dynamic changes of risk factors with time. Risk Management and Change Management processes are inextricably interwoven and need to be closely integrated in any Enterprise Risk Management ERM System.

2. Human Factors

This version of the HoRC recognises that ultimately the effectiveness of ALL risk controls relies on human actions and inactions – *designers, makers, installers, users, maintainers, operators, supervisors, managers, etc.* Humans are involved in ALL risk factors - 100% - not 75% or 80% or any other often quoted percentage. Human actions and inactions are at the heart of all causes and all solutions. This is not directed at blame. On discovery of an actual or possible human action / inaction, the next, immediate consideration is to clarify which human factors were involved and importantly to establish if there is/was any conscious **choice or intent** affecting those actions or inactions. If NO choice or intent, there is/was always an ergonomic mismatch of work demands and human capabilities. The risk control solutions also need to be ergonomic.

As well, it must also be remembered that the often quoted involvement of "human errors" in incident and risk causation does not recognise that **error while being a direct or immediate cause** – *is actually a consequence* of deeper underlying systemic and organisational root causes, which in turn, always involve other human limitations.

There are always "good" underlying reasons for supposed errors. Those reasons need to be detected & analysed. Conscious behaviours that do involve choice and intent can never actually be labelled *careless, stupid and lazy*. Our conscious chosen behaviours are always perceived as returning desired personal, or social or corporate benefits. At the time, the chances of the conscious chosen behaviours leading to positive outcomes - *gain, benefit, profit* - are perceived as better than the chances of negative outcomes - *loss or harm*. No one ever takes a risk for the chance of loss or harm.

The net effect of this criterion of the HoRC is the recognition that human reliability is limited by physical / psychological / physiological consistency, endurance and resilience. As such, a physical / engineering HARD risk control should be the priority choice over a behavioural SOFT risk control. However, in practice, mixes of both SOFT & HARD controls are always needed to support each other. It is usually not an either / or choice.

3. Effectiveness

The ultimate test of risk management is – how effective are the risk controls in securing risk levels that meet your moral, legal, and financial objectives? Are the controls being implemented?, in place? and working? so that they reduce the risk level as planned and intended? Effectiveness is strongly related to the other 3 attributes in Table 1. It is worth noting that effectiveness of a single risk control or set of risk controls can be measured by the **reduction of risk level** from the **current residual risk level** BEFORE, to the proposed **target residual risk level** AFTER implementing the proposed new, different or changed controls. This improvement or reduction would be the "Benefit" in a CBA Cost Benefit Analysis in Part 4.

Many organisations grossly overestimate the effectiveness of SOFT risk controls such as training, procedures and discipline, and consequently formulate their Safety Risk Management strategies almost solely on them even though they are at the bottom of the HoRC. Qualitative and Semi-quantitative measures of effectiveness have been developed with an example in Tables 3A, 3B and 3C.

Control Rating	Definition of Control Effectiveness Rating
Damaging	These controls increase the risk in particular circumstances, requiring controls in similar situations in other areas of the operations to be reappraised.
None	No controls are in place.
Deficient	Controls that have been applied are not adequate for the job i.e. up to the standard needed for the job. At best, control addresses risk, however is not documented or in operation; at worst control does not address risk and cannot be relied to work consistently.
Marginal	Controls that have been applied go part of the way to reduce the risk or impact, but documentation and/or operation of control could be improved.
Qualified	Controls that have been applied go a reasonable way to reduce the risk or impact, but documentation and/or operation of control could be improved.
Effective	Controls that have been applied are value for money in reducing the risk or impact. Control addresses risk, is officially documented and in operation.
Excessive	The controls that have been applied are more than necessary to reduce the risk or impact. There may be some over control here.

Table 3A Qualitative Rating of Control Effectiveness [private communication from an author's client]

	Does the control address the risk effectively?	Is the control officially documented?	Is the control in operation and applied consistently?	Is the control more than necessary?	Does the control increase the risk?
Yes	1	1	1	1	15
Partly	3	2	2	2	10
No	6	3	3	3	1
Add Estimates	()	+ ()	+ ()	+ ()	+ ()
				Total Control Rating	= ()

Table 3B Semi-Quantitative Rating of Effectiveness [private communication from an author's client]

Control Rating	One Control	Two Controls	Three Controls	Four Controls	Five Controls
Damaging	17 plus	33 plus	49 plus	65 plus	81 plus
None	16	31 to 32	46 to 48	61 to 64	76 to 80
Deficient	11 to 15	21 to 30	31 to 45	41 to 60	51 to 75
Marginal	9 to 10	17 to 20	25 to 30	33 to 40	41 to 50
Qualified	8	15 to 16	22 to 24	29 to 32	36 to 40
Effective	7	13 to 14	19 to 21	25 to 28	31 to 35
Excessive	5 to 6	10 to 12	15 to 18	20 to 24	25 to 30

Table 3C Control Effectiveness Rating [private communication from an author's client]

4. Cost / Benefit

Item (e) Table 2 describes cost of a risk control as one valid criterion for prioritisation of choice. However there is a strong qualifier expressed as – a Risk Level is ALARP if the cost of further risk level reduction is “grossly disproportionate” to benefit gained. As an aside, often the differences in cost of HARD and SOFT risk controls can be only apparent. SOFT controls can cost more than first thought. Also lack of “Capacity to Pay” can never be a morally nor legally defensible reason for not implementing an appropriate risk control.

Notes on Use of the HoRC

Any version of the HoRC needs : -

- a) to be applied **during both the Risk Identification and the Risk Control / Treatment** stages of a Risk Management process. The nature and effectiveness of existing risk controls needs to be specified BEFORE and AFTER the Risk Analysis and Evaluation stages. [Fig 1]
- b) to recognise & respond to the reality that ultimately the effectiveness of **EVERY control relies on humans** – *designers, makers, installers, users, maintainers, operators, supervisors, managers.*
- c) to be used to choose a multiple **complementary mix of HARD & SOFT controls** to cope with the possibility and likelihood of ALL of them not working or missing at the same time. Always have multiple controls from both ends of the hierarchy.
e.g. a machine guard still needs to be checked that it is being used OR a rule always requires effective & efficient design of required tools equipment & methods & related knowledge, skill, supervision.
- d) to never lead to reliance solely on **reactive Risk Controls** that reduce / mitigate Consequences only –
e.g. rescue, evacuation, first aid, firefighting, bunding. Comprehensively managing risk requires **proactive Risk Controls** to minimise risk by reducing Likelihood as well as Consequence.

Bibliography & References

Gibbs CJ 1982 Turner v. The State of South Australia (1982). High Court of Australia before Gibbs CJ, Murphy, Brennan, Deane and Dawson JJ.

Anon 2011 QLD Work Health and Safety Act 2011 Part 2 Health and safety duties