Expanding Severity and Likelihood codes in Safety and Health Risk Assessments

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ABSTRACT

Safety and Health Risk Assessment is a combination of likelihood and severity of the hazard. Different definitions and statement has been used for likelihood and severity. This paper attempts to consolidate by expanding severity and likelihood codes or statements for a realistic safety and health risk assessments. Likelihood in expanded version includes probability, levels of controls, behaviour, culture and attitudes, likely of occurrence, exposure levels, morale, and number of people likely to be affected, and training. Severity in broader sense includes the degree of injury to people and property (which can also mean near miss).

Key terms used:

Codes,
Hazard,
Likelihood,
Risk Assessment,
Severity

1. INTRODUCTION

The safety and health risk*1 associated with any work activity depends on the severity of an accident or ill health that may occur, and the likelihood of its occurrence. All safety and health risks at work can be controlled, and all accidents or ill health can be prevented. Safety and Health (SH) Risk Management is a process by which the organization's management assesses the risks, determines the control measures and takes appropriate actions to reduce such risks. Anything that has the potential to cause harm is generally defined as a hazard. The combination of the likelihood*2 of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s) is termed as risk. Different models use different definitions for severity and likelihood. Risk Assessment Code (RAC)*3 – A hazard number ranking system from 1 (the highest level of risk) to 5 (the lowest level of risk). Risk Assessment Matrix – A tool used to assign RACs.

Likelihood Code *3 (A through D) indicating the probability or chance of an event actually occurring is shown in Table-1.

Level	Likelihood	Description
A	Frequent	Immediate danger to the health and safety of the public, staff, resources, or property; occurs frequently or continuously.
B	Likely	Probably will occur in time if not corrected, or probably will occur one or more times during the life of the system

C	Occasional	Possible to occur in time if not corrected.
D	Rarely	Unlikely to occur, may assume exposure will not occur.

Table 1 Likelihood code

Consequence Code – Code (I through IV) indicating the severity of consequence resulting from exposure to a hazard is shown in Table -2

Level	Severity	Description
1.	Catastrophic	Imminent and immediate danger of death or permanent disability, chronic or irreversible illness, major property or resource damage.
2.	Critical	Permanent partial disability, temporary total disability greater than 3 months, significant property or resource damage
3.	Significant	Hospitalized minor injury, reversible illness, period of disability of 3 months or less, loss or restricted workday accident, compensable injury or illness, minor property or resource damage
4.	Minor	First aid or minor medical treatment. Presents minimal threat to human safety and health, property, or resources, but is still in violation of a standard

Table 2 Severity code

The SEP*5 model defines Risk (R) = Severity x Probability x Exposure or R = S x P x E. Here a third dimension of Exposure is given.

Following table -3 summarises the SEP model.

Level	Severity	Likelihood/Probability	Exposure
1	none or slight	Impossible or remote under normal conditions	None or below average
2	Minimal	Unlikely under normal conditions	Average
3	Significant	50/50 chance	Above average
4	Major	Greater than 50% chance	Great
5	Catastrophic.	Very likely Exposure	

Table 3 SEP model

Other model considers*6 possible harm to employees, contractors, members of the public, those using products and services and anyone else affected by the activity, such as neighbours Other consideration is given for persons who could be affected in different groups, such as young or inexperienced workers, pregnant workers, workers with a disability, migrant workers or ageing workers. As safety and health is beyond traditional risk, it is important to be aware that human failure is not random; understanding why errors occur and the different factors which make them worse will help you develop more effective controls. There are two main types of human failure: errors (Some errors are slips or lapses, often "actions that were not as planned" or unintended actions, Other errors are Mistakes or errors of judgement or decision-making where the "intended actions are wrong" i.e. where we do the wrong thing believing it to be right.) and violations (non-compliances, circumventions, shortcuts and workaround) differ from the above in that they are intentional but usually well-meaning failures where the person deliberately does not carry out the procedure correctly). A violation*7 is a deliberate deviation from a rule or procedure. A three-dimensional method, utilizes the traditional Likelihood (Y-axis) and Severity (X-axis), while adding a new, third dimension, as the Z-axis, and referred to as the Level of Control. Risk assessment*9 is to consider as who might be harmed and how, such as how your employees could be harmed by business activities or external factors. Translating Strength of Controls*10 into Likelihood, the problem remains of associating likelihood with strength of potential controls. In system concept development and in early decisions about the development process (e.g., where to invest resources), an

estimate of the potential strength of designed controls for the scenarios would be used to assess likelihood.

Various strategies might be used to rank the strength of potential controls as shown in table -4.

Ranking strength of controls	Description
1.	The causal factor can be eliminated through design and high assurance
2.	The occurrence of the causal factor can be reduced or controlled through system design
3.	The causal factor can be detected and mitigated if it does occur through system design or through operational procedures
4.	The only potential controls involve training and procedures

Table 4 Strength of Controls

A guide to severity rating *11 described as shown in table -5

Level	Severity	Description
5	Catastrophic Death	Fatal diseases or multiple major injuries
4	Major	Serious injuries or life-threatening occupational diseases (includes amputations, major fractures, multiple injuries, occupational cancers, acute poisoning, disabilities and deafness).
3	Moderate	Injury or ill-health requiring medical treatment (includes lacerations, burns, sprains, minor fractures, dermatitis and work-related upper limb disorders)
2	Minor	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort).
1	Negligible	Negligible injury

Table 5 Severity rating

A guide to Likelihood rating *11 described as shown in table -6

Level	likelihood	Description
5	Almost Certain	Continual or repeating experience
4	Frequent	Common occurrence
3	Occasional	Possible or known to occur
2	Remote	Not likely to occur under normal circumstances
1	Rare	Not expected to occur but still possible

Table 6 Likelihood rating

According to McGregor*12, Theory X person assumes the Work is inherently distasteful to most people, and they will attempt to avoid work whenever possible and Theory Y presents an optimistic view of the employees' nature and behaviour at work. Thus Theory Y person is likely to cause an incident, while Theory X person is more likely to cause incidents. Work attitude*13 not only affects how well people do their job, but it also affects how safe they are when doing it. Positive people usually perform better in the workplace because they maintain an open mind and consider the outcome of their behaviour. Negative people, on the other hand, complain about everything, including having to practice safety. A negative work attitude can lead to unsafe work habits and accidents. Negative workplace behaviour, such as workplace bullying, is an important work-related psychosocial hazard with the potential to contribute to employee ill-health. There is a need to expand the statements used in severity and likelihood so as to make a comprehensive risk assessments.

2. OBJECTIVE

Key objective of this paper is to have an inclusive definition for severity and likelihood for assessing safety and health risk.

3. METHOD

Different models have varied definitions for severity and likelihood for a safety and health risk assessment. The following 3 steps are adopted for this model. Step 1: Summarising the broad parameters used for severity and probability/Likelihood are: Severity - Injuries to people and property damage. Likelihood or probability - level of controls, likely to occur, behaviour/culture, exposure levels, morale, attitude and number of people likely to be affected, and training. The level of controls includes training, well-written procedures, supervision and instructions Step 2: Creating severity and likelihood codes/rankings. For this exercise, 5x5 matrix is adopted. This step is to have a severity and likelihood table.

Table 7 and 8 identifies the broad definitions and statement that can be used for Likelihood and Severity respectively.

Attributes	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Statement	Not expected to occur but still possible, Impossible or remote under normal conditions	Not likely to occur under normal circumstances	Possible or known to occur, 50/50 chance	A common occurrence, Greater than 50% chance	Continual or repeating experience, Very likely chance
Level of existing controls	Great engineering controls and good supervision, instruction and training	Above Average controls	Average controls with good supervision, instruction, training	The only potential controls involve training and procedures.	None or no controls The only potential controls having procedures.
Morale	Extremely high	High morale	Moderate morale	Low morale	Very low morale
Culture	Excellent organisation culture	High positive organisation culture	Moderate positive organisation culture	Low or negative organisation culture	Very low organisation culture
Behaviour	100% Theory Y personnel	>50% Theory Y personnel	25-50% Theory Y personnel	> 50% Theory X personnel	100% Theory X personnel

Exposure How many people are likely to be exposed to the hazard?	One or small group	Many people	One or small group and specific groups vulnerable than others	Many and vulnerable groups such as people with mental stress/ pre-existing medical condition	Many and specific groups more vulnerable people with disabilities, pregnant women
Casual Factors	The casual factor can be eliminated through design and high assurance	The occurrence of the casual factor can be reduced or controlled through system design	The causal factor can be detected and mitigated if it does occur through system design	The causal factor is difficult to be detected	The causal factor cannot be detected
Probability of occurrence	Very rarely to occur	Possible to occur in time if not corrected	Possible to occur one or more times during the life of the system	Possible to occur many more times	Possible to occur frequently

Table 7 Likelihood statements

Attributes	none or slight (1)	Minimal (2)	Significant (3)	Major/Critical (4)	Catastrophe (5)
Statement	Negligible injury	Mild Injury which can be treated in house	Treatment by external such as hospital	Treatment requiring hospitalisation	Fatality
Property Damage	No property damage	Mild property, or resources	Moderate property or resource damage	significant property or resource damage	major property or resource damage

Injury	Negligible injury	First aid or minor medical treatment. Presents minimal threat to human safety and health,	• Hospitalized minor injury, reversible illness, period of disability of 3 months or less, loss or restricted workday accident, compensable injury or illness • Injury or ill health requiring medical treatment (includes lacerations, burns, sprains, minor fractures, dermatitis and work-related upper limb disorders)	• Permanent partial disability, temporary total disability greater than 3 months • Serious injuries or life-threatening occupational diseases (includes amputations, major fractures, multiple injuries, occupational cancers, acute poisoning, disabilities and deafness).	• Imminent and immediate danger of death or permanent disability, chronic or irreversible illness • Fatal diseases or multiple major injuries
Reputation	No impact	Temporary impact on the reputation	Mild reputation damage still can be managed through public relations	Moderate impact on business	Serious impact, potentially leading to the closure

Table 8 Severity statements

Step 3 – Evaluate Risk using the matrix (in numbers and words) are shown in Table 9 and 10:

Likelihood / Severity	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Table 9 Example of a common 5x5 Risk Matrix*4 with a mix of numeric and descriptive ratings

Likelihood / Severity	Rare (1)	Unlikely (2)	Possibly (3)	Likely (4)	Almost Certain (5)
Catastrophic (A)	Medium	Medium	High	High	High
Major (B)	Medium	Medium	Medium	High	High
Moderate (C)	Low	Medium	Medium	Medium	High
Minor (D)	Low	Medium	Medium	Medium	Medium
Insignificant (E)	Low	Low	Low	Medium	Medium

Table 10 Example of a common 5x5 Risk Matrix with a mix of words and descriptive ratings

4. RESULTS AND DISCUSSIONS

When computing likelihood or severity code, it should be evaluated against all possible attributes. In situations, where one of the attributes falls in different codes, highest code should be taken. For example, if morale of staff is very high, but there are no controls, likelihood should be taken as almost certain (5). Similarly, for Severity. Likelihood and severity are qualitative and hence to the best of

knowledge, codes or ratings should be given. There may be other attributes such as duration of exposure, which can be decided by the team conducting the risk assessments. This model is based on 5x5 matrix of risk assessment. Should anyone wish to use other matrix such as 3x3, statements or codes mentioned in Table 7 and 8 has to be modified. Conclusions Having a comprehensive category for severity and likelihood, risk assessments can be more realistic.

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