

Risk assessment

Broadly speaking, a **risk assessment** is the combined effort of:

1. identifying and analyzing potential (future) events that may negatively impact individuals, assets, and/or the environment (i.e. [hazard analysis](#)); and
2. making judgments "on the [tolerability](#) of the risk on the basis of a risk analysis" while considering influencing factors (i.e. risk evaluation).^{[1][2]}

Put in simpler terms, a risk assessment determines possible mishaps, their likelihood and consequences, and the tolerances for such events.^[1] The results of this process may be expressed in a [quantitative](#) or [qualitative](#) fashion. Risk assessment is an inherent part of a broader [risk management](#) strategy to help reduce any potential risk-related consequences.^{[1][2]}

Need

Individual risk assessment

Risk assessment is necessary in individual cases, including patient and physician interactions.^[3] Individual judgements or assessments of risk may be affected by psychological, ideological, religious or otherwise subjective factors, which impact rationality of the process.^[3]

A [systematic review](#) of patients and doctors from 2017 found that overstatement of benefits and understatement of risks occurred more often than the alternative.^{[3][4]}

There is a tendency for individuals to be less rational when risks and exposures concern themselves as opposed to others.^[3] There is also a tendency to underestimate risks that are voluntary or where the individual sees themselves as being in control, such as smoking.^[3] A 2017 systematic review from the [Cochrane collaboration](#) suggests "well-documented decision aids" are helpful in reducing effects of such tendencies or biases.^{[3][5]} The ways statistics are expressed and communicated, both through words and numerically also impact the interpretation of benefit and harm. For example, a fatality rate may be interpreted as less benign than the corresponding survival rate.^[3]

Systems risk assessment

Risk assessment can also be made on a much larger "systems" scale, for example assessing the risks of a nuclear power plant (an interactively complex mechanical, electronic, nuclear, and human system) or a hurricane (a complex meteorological and geographical system). Systems may be defined as linear and nonlinear (or complex), where linear systems are predictable and relatively easy to understand given a change in input, and non-linear systems unpredictable when inputs are changed.^[6] As such, risk assessments of non-linear/complex systems tend to be more challenging.

In the engineering of complex systems, sophisticated risk assessments are often made within [safety engineering](#) and [reliability engineering](#) when it concerns threats to life, [environment](#), or machine functioning. The agriculture, nuclear, aerospace, oil, railroad, and military industries have a long history of dealing with risk assessment.^[7] Also, medical, hospital, [social service](#),^[8] and food industries control risks and perform risk assessments on a continual basis. Methods for assessment of risk may differ between industries and whether it pertains to general financial decisions or environmental, ecological, or public health risk assessment.^[7]

Concept

Rapid technological change, increasing scale of industrial complexes, increased system integration, market competition, and other factors have been shown to increase societal risk in the past few decades.^[1] As such, risk assessments become increasingly critical in mitigating accidents, improving safety, and improving outcomes. Risk assessment consists of an objective evaluation of [risk](#) in which assumptions and uncertainties are clearly considered and presented. This involves identification of risk (what can happen and why), the potential consequences, the [probability of occurrence](#), the tolerability or [acceptability](#) of the risk, and ways to mitigate or

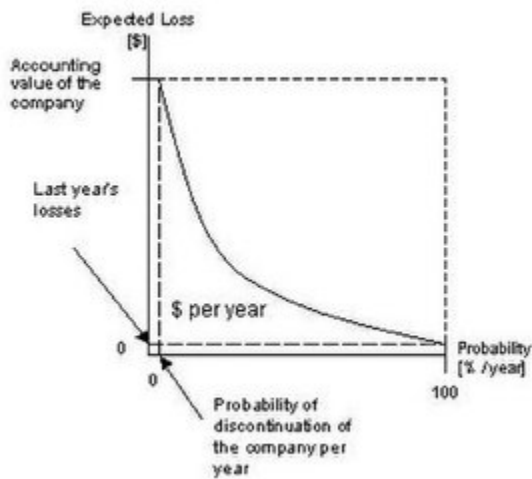
reduce the probability of the risk.^[2] Optimally, it also involves documentation of the risk assessment and its findings, implementation of mitigation methods, and review of the assessment (or risk management plan), coupled with updates when necessary.^[1] Sometimes risks can be deemed acceptable, meaning the risk "is understood and tolerated ... usually because the cost or difficulty of implementing an effective countermeasure for the associated vulnerability exceeds the expectation of loss."^[9]

Part of the difficulty in managing risk is that both the quantities by which risk assessment is concerned—potential loss and probability of occurrence—can be very difficult to measure. The chance of error in measuring these two concepts is high. The risk with a large potential loss and a low probability of occurrence is often treated differently from one with a low potential loss and a high likelihood of occurrence. In theory, both are of near equal priority, but in practice, it can be very difficult to manage when faced with the scarcity of resources—especially time—in which to conduct the risk management process.

Mild Versus Wild Risk

Benoit Mandelbrot distinguished between "mild" and "wild" risk and argued that risk assessment and management must be fundamentally different for the two types of risk.^[10] Mild risk follows [normal](#) or near-normal [probability distributions](#), is subject to [regression to the mean](#) and the [law of large numbers](#), and is therefore relatively predictable. Wild risk follows [fat-tailed distributions](#), e.g., [Pareto](#) or [power-law distributions](#), is subject to regression to the tail (infinite mean or variance, rendering the law of large numbers invalid or ineffective), and is therefore difficult or impossible to predict. A common error in risk assessment and management is to underestimate the wildness of risk, assuming risk to be mild when in fact it is wild, which must be avoided if risk assessment and management are to be valid and reliable, according to Mandelbrot.

Mathematical conceptualization



Risk assessment from a financial point of view.

To see the risk management process expressed mathematically, one can define total risk as the sum over individual risks, R_i , which can be computed as the product of potential losses, L_i , and their probabilities, $p(L_i)$:

$$R_i = L_i p(L_i)$$

$$R_{total} = \sum_i L_i p(L_i)$$

Even though for some risks R_i, R_j , we might have $R_i = R_j$, if the probability $p(L_j)$ is small compared to $p(L_i)$, its estimation might be based only on a smaller number of prior events, and hence, more uncertain. On the other hand, since $R_i = R_j$, L_j must be larger than L_i , so decisions based on this uncertainty would be more consequential, and hence, warrant a different approach.

Financial decisions, such as insurance, express loss in terms of dollar amounts. When risk assessment is used for public health or environmental decisions, the loss can be quantified in a common metric such as a country's currency or some numerical measure of a location's quality of life. For public health and environmental decisions, the loss is simply a verbal description of the outcome, such as increased cancer incidence or incidence of birth defects. In that case, the "risk" is expressed as

$$R_i = p(L_i)$$

If the risk estimate takes into account information on the number of individuals exposed, it is termed a "population risk" and is in units of expected increased cases per time period. If the risk estimate does not take into account the number of individuals exposed, it is termed an "individual risk" and is in units of incidence rate per time period. Population risks are of more use for cost/benefit analysis; individual risks are of more use for evaluating whether risks to individuals are "acceptable".

Quantitative risk assessment

In quantitative risk assessment, an [annualized loss expectancy](#) (ALE) may be used to justify the cost of implementing countermeasures to protect an asset. This may be calculated by multiplying the [single loss expectancy](#) (SLE), which is the loss of value based on a single security incident, with the [annualized rate of occurrence](#) (ARO), which is an estimate of how often a threat would be successful in exploiting a vulnerability.

The usefulness of quantitative risk assessment has been questioned, however. [Barry Commoner](#), [Brian Wynne](#) and other critics have expressed concerns that risk assessment tends to be overly quantitative and reductive. For example, they argue that risk assessments ignore qualitative differences among risks. Some charge that assessments may drop out important non-quantifiable or inaccessible information, such as variations among the classes of people exposed to hazards, or social amplification.^[11] Furthermore, Commoner and O'Brien claim that quantitative approaches divert attention from precautionary or preventative measures.^[12] Others, like [Nassim Nicholas Taleb](#) consider risk managers little more than "blind users" of statistical tools and methods.^[13]

Assessment of risk

The process of risk assessment may be somewhat informal at the individual social level, managing economic and household risks,^{[14][15]} or a sophisticated process at the strategic corporate level. However, in both cases, ability to anticipate future events and create effective strategies for mitigating them when deemed unacceptable is vital.

At the individual level, a simple process of identifying objectives and risks, weighing their importance, and creating plans, may be all that's necessary. At the strategic organisational level, more elaborate policies are necessary, specifying acceptable levels of risk, procedures to be followed within the organisation, priorities, and allocation of resources.^{[16]:10} At the systematic level, management involved with the project produce project level risk assessments with the

assistance of the available expertise as part of the planning process and set up systems to ensure that required actions to manage the assessed risk are in place. At the dynamic level, the personnel directly involved may be required to deal with unforeseen problems in real time. The tactical decisions made at this level should be reviewed after the operation to provide feedback on the effectiveness of both the planned procedures and decisions made in response to the contingency.

The first step in risk assessment is to establish the context. This restricts the range of hazards to be considered.

This is followed by *identification of visible and implied hazards* that may threaten the project, and *determining the qualitative nature of the potential adverse consequences* of each hazard. Without a potential adverse consequence, there is no hazard.

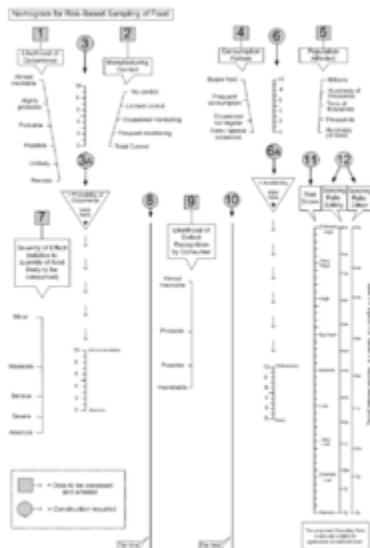
It is also necessary to identify the potential parties or assets which may be affected by the threat, and the potential consequences to them if the hazard is activated.

If the consequences are dependent on dose, i.e. the amount of exposure, the relationship between dose and severity of consequence must be established, and the risk depends on the probable dose, which may depend on concentration or amplitude and duration or frequency of exposure. This is the general case for many health hazards where the mechanism of injury is toxicity or repetitive injury, particularly where the effect is cumulative.

For other hazards, the consequences may either occur or not, and the severity may be extremely variable even when the triggering conditions are the same. This is typical of many biological hazards as well as a large range of safety hazards. Exposure to a pathogen may or may not result in actual infection, and the consequences of infection may also be variable. Similarly, a fall from the same place may result in minor injury or death, depending on unpredictable details. In these cases, estimates must be made of reasonably likely consequences and associated probability of occurrence.

In cases where statistical records are available, they may be used to evaluate risk, but in many cases, there are no data or insufficient data available to be useful. Mathematical or experimental models may provide useful input.

Dose dependent risk



Food risk assessment *nomogram*

1. *Dose-Response Analysis*, is determining the relationship between dose and the type of adverse response and/or probability or the incidence of effect (dose-response assessment). The complexity of this step in many contexts derives mainly from the need to extrapolate results from experimental animals (e.g. [mouse](#), [rat](#)) to humans, and/or from high to lower doses, including from high acute occupational levels to low chronic environmental levels. In addition, the differences between individuals due to [genetics](#) or other factors mean that the hazard may be higher for particular groups, called susceptible populations. An alternative to dose-response estimation is to determine a concentration unlikely to yield observable effects, that is, a [no effect concentration](#). In developing such a dose, to account for the largely unknown effects of animal to human extrapolations, increased variability in humans, or missing data, a prudent approach is often adopted by including safety or uncertainty factors in the estimate of the "safe" dose, typically a factor of 10 for each unknown step.
2. *Exposure Quantification*, aims to determine the amount of a contaminant (dose) that individuals and populations will receive, either as a contact level (e.g., concentration in ambient air) or as intake (e.g., daily dose ingested from drinking water). This is done by examining the results of the discipline of [exposure assessment](#). As a different location, lifestyle, and other factors likely influence the amount of contaminant that is received, a range or distribution of possible values is generated in this step. Particular care is taken to determine the exposure of the susceptible population(s).

The results of these steps are combined to produce an estimate of risk. Because of the different susceptibilities and exposures, this risk will vary within a population. An uncertainty analysis is usually included in a health risk assessment.

Dynamic risk assessment

During an emergency response, the situation and hazards are often inherently less predictable than for planned activities (non-linear). In general, if the situation and hazards are predictable (linear), standard operating procedures should deal with them adequately. In some emergencies, this may also hold true, with the preparation and trained responses being adequate to manage the situation. In these situations, the operator can manage risk without outside assistance, or with the assistance of a backup team who are prepared and available to step in at short notice.

Other emergencies occur where there is no previously planned protocol, or when an outsider group is brought in to handle the situation, and they are not specifically prepared for the scenario that exists but must deal with it without undue delay. Examples include police, fire department, disaster response, and other public service rescue teams. In these cases, ongoing risk assessment by the involved personnel can advise appropriate action to reduce risk.^[16] HM Fire Services Inspectorate has defined dynamic risk assessment (DRA) as:

The continuous assessment of risk in the rapidly changing circumstances of an operational incident, in order to implement the control measures necessary to ensure an acceptable level of safety.^[16]

Dynamic risk assessment is the final stage of an integrated safety management system that can provide an appropriate response during changing circumstances. It relies on experience, training and continuing education, including effective debriefing to analyse not only what went wrong, but also what went right, and why, and to share this with other members of the team and the personnel responsible for the planning level risk assessment.^[16]

Fields of application

The application of risk assessment procedures is common in a wide range of fields, and these may have specific legal obligations, codes of practice, and standardised procedures. Some of these are listed here.

Human settlements

The importance of risk assessments to manage the [consequences of climate change](#) and variability is recalled in the global frameworks for Disaster Risk Reduction (DRR), adopted by the member countries of the United Nations at the end of the World Conferences held in Kobe (2005) and Sendai (2015). The Sendai framework for DRR brings attention to the local scale and encourages a holistic risk approach, which should consider all the hazards to which a community is exposed, the integration of technical-scientific knowledge with local knowledge, and the inclusion of the concept of risk in local plans to achieve a significant disaster reduction by 2030. Taking these principles into daily practice poses a challenge for many countries. The Sendai framework for DRR monitoring system highlights how little we know about the progress made over the past five years in local disaster risk reduction.^[17]

Sub-Saharan Africa

Exceptions aside, in the South of the Sahara, risk assessment is not yet an institutionalized practice. The exposure of human settlements to multiple hazards (hydrological and agricultural drought, pluvial, fluvial and coastal floods) is frequent and requires risk assessments on a regional, municipal, and sometimes individual human settlement scale. The multidisciplinary approach and the integration of local and technical-scientific knowledge are necessary from the first steps of the assessment. Local knowledge remains unavoidable to understand the hazards that threaten individual communities, the critical thresholds in which they turn into disasters, for the validation of hydraulic models, and in the decision-making process on risk reduction. On the other hand, local knowledge alone is not enough to understand the impacts of future changes and climatic variability and to know the areas exposed to infrequent hazards. The availability of new technologies and [open access](#) information (high resolution satellite images, daily rainfall data) allow assessment today with an accuracy that only 10 years ago was unimaginable. The images taken by unmanned vehicle technologies allow to produce very high resolution digital elevation models and to accurately identify the receptors.^[18] Based on this information, the hydraulic models allow the identification of flood areas with precision even at the scale of small settlements.^[19] The information on loss and damages and on cereal crop at individual settlement scale allow to determine the level of multi-hazard risk on a regional scale.^[20] The multi-temporal high-resolution satellite images allow to assess the hydrological drought and the dynamics of human settlements in the flood zone. Risk assessment is much more than an aid to informed decisions making about risk reduction or acceptance.^[21] It integrates early warning systems by highlighting the hot spots where disaster prevention and preparedness are most

urgent.^[22] When risk assessment considers the dynamics of exposure over time, it helps to identify risk reduction policies that are more appropriate to the local context. Despite these potentials, the risk assessment is not yet integrated into the local planning in the South of the Sahara which, in the best of cases, uses only the analysis of [vulnerability to climate change](#) and variability.^[23]

General health

There are many resources that provide health risk information.

The [National Library of Medicine](#) provides risk assessment and regulation information tools for a varied audience.^[24] These include:

- TOXNET (databases on hazardous chemicals, environmental health, and toxic releases),^[25]
- the Household Products Database (potential health effects of chemicals in over 10,000 common household products),^[26]
- TOXMAP (maps of the [U.S. Environmental Protection Agency Superfund](#) and [Toxics Release Inventory](#) data).

The [United States Environmental Protection Agency](#) provides basic information about environmental health risk assessments for the public for a wide variety of possible environmental exposures.^[27]

The Environmental Protection Agency began actively using risk assessment methods to protect drinking water in the United States after the passage of the Safe Drinking Water Act of 1974. The law required the National Academy of Sciences to conduct a study on drinking water issues, and in its report, the NAS described some methodologies for doing risk assessments for chemicals that were suspected carcinogens, recommendations that top EPA officials have described as perhaps the study's most important part.^[28]

Considering the increase in junk food and its toxicity, FDA required in 1973 that cancer-causing compounds must not be present in meat at concentrations that would cause a cancer risk greater than 1 in a million over a lifetime. The US Environmental Protection Agency provides extensive information about ecological and environmental risk assessments for the public via its risk assessment portal.^[29] The [Stockholm Convention](#) on [persistent organic pollutants](#) (POPs) supports a qualitative risk framework for public health protection from chemicals that display environmental and biological persistence, [bioaccumulation](#), toxicity (PBT) and long range

transport; most global chemicals that meet this criteria have been previously assessed quantitatively by national and international health agencies.^[30]

Small sub-populations

When risks apply mainly to small sub-populations, it can be difficult to determine when intervention is necessary. For example, there may be a risk that is very low for everyone, other than 0.1% of the population. It is necessary to determine whether this 0.1% is represented by:

- all infants younger than X days or
- recreational users of a particular product.

If the risk is higher for a particular sub-population because of abnormal exposure rather than susceptibility, strategies to further reduce the exposure of that subgroup are considered. If an identifiable sub-population is more susceptible due to inherent genetic or other factors, public policy choices must be made. The choices are:

- to set policies for protecting the general population that are protective of such groups, e.g. for children when data exists, the Clean Air Act for populations such as asthmatics or
- not to set policies, because the group is too small, or the costs too high.

Acceptable risk criteria

Acceptable risk is a risk that is understood and tolerated usually because the cost or difficulty of implementing an effective countermeasure for the associated vulnerability exceeds the expectation of loss.^[31]

The idea of not increasing lifetime risk by more than one in a million has become commonplace in public health discourse and policy.^[32] It is a heuristic measure. It provides a numerical basis for establishing a negligible increase in risk.

Environmental decision making allows some discretion for deeming individual risks potentially "acceptable" if less than one in ten thousand chance of increased lifetime risk. Low risk criteria such as these provide some protection for a case where individuals may be exposed to multiple chemicals e.g. pollutants, food additives, or other chemicals.

In practice, a true zero-risk is possible only with the suppression of the risk-causing activity.

Stringent requirements of 1 in a million may not be technologically feasible or may be so prohibitively expensive as to render the risk-causing activity unsustainable, resulting in the

optimal degree of intervention being a balance between risks vs. benefit. For example, emissions from hospital incinerators result in a certain number of deaths per year. However, this risk must be balanced against the alternatives. There are public health risks, as well as economic costs, associated with all options. The risk associated with no [incineration](#) is the potential spread of infectious diseases or even no hospitals. Further investigation identifies options such as separating noninfectious from infectious wastes, or air pollution controls on a medical incinerator.

Intelligent thought about a reasonably full set of options is essential. Thus, it is not unusual for there to be an iterative process between analysis, consideration of options, and follow up analysis.

Auditing

For audits performed by an outside audit firm, risk assessment is a crucial stage before accepting an audit engagement. According to ISA315 *Understanding the Entity and its Environment and Assessing the Risks of Material Misstatement*, "the auditor should perform risk assessment procedures to obtain an understanding of the entity and its environment, including its internal control". Evidence relating to the auditor's risk assessment of a material misstatement in the client's financial statements. Then, the auditor obtains initial evidence regarding the classes of transactions at the client and the operating effectiveness of the client's internal controls. Audit risk is defined as the risk that the auditor will issue a clean unmodified opinion regarding the financial statements, when in fact the financial statements are materially misstated, and therefore do not qualify for a clean unmodified opinion. As a formula, audit risk is the product of two other risks: Risk of Material Misstatement and Detection Risk. This formula can be further broken down as follows: [inherent risk](#) × [control risk](#) × [detection risk](#).

Public health

In the context of [public health](#), risk assessment is the process of characterizing the nature and likelihood of a harmful effect to individuals or populations from certain human activities. Health risk assessment can be mostly qualitative or can include statistical estimates of probabilities for specific populations. In most countries, the use of specific chemicals or the operations of specific facilities (e.g. power plants, manufacturing plants) is not allowed unless it can be shown that they do not increase the risk of death or illness above a specific threshold. For example, the

American [Food and Drug Administration](#) (FDA) regulates food safety through risk assessment, while the [EFSA](#) does the same in EU.^[33]

An [occupational risk assessment](#) is an evaluation of how much potential danger a [hazard](#) can have to a person in a workplace environment. The assessment takes into account possible scenarios in addition to the probability of their occurrence and the results.^[34] The five types of hazards to be aware of are safety (those that can cause injury), [chemicals](#), [biological](#), [physical](#), and [ergonomic](#) (those that can cause [musculoskeletal disorders](#)).^[35] To appropriately assess hazards there are two parts that must occur. Firstly, there must be an "[exposure assessment](#)" which measures the likelihood of worker contact and the level of contact. Secondly, a "risk characterization" must be made which measures the probability and severity of the possible health risks.^[36]

Project management

In [project management](#), risk assessment is an integral part of the risk management plan, studying the probability, the impact, and the effect of every known risk on the project, as well as the corrective action to take should an incident be implied by a risk occur.^[37] Of special consideration in this area are the relevant codes of practice that are enforced in the specific jurisdiction. Understanding the regime of regulations that risk management must abide by is integral to formulating safe and compliant risk assessment practices.

Information security

[Information technology risk](#) assessment can be performed by a qualitative or quantitative approach, following different methodologies. One important difference in risk assessments in information security is modifying the threat model to account for the fact that any adversarial system connected to the Internet has access to threaten any other connected system.^[38] Risk assessments may therefore need to be modified to account for the threats from all adversaries, instead of just those with reasonable access as is done in other fields.

NIST Definition: The process of identifying risks to organizational operations (including mission, functions, image, reputation), organizational assets, individuals, other organizations, and the Nation, resulting from the operation of an information system. Part of risk management incorporates threat and vulnerability analyses and considers mitigations provided by security controls planned or in place.^[39]

Cybersecurity

The **Threat and Risk Assessment (TRA)** process is part of risk management referring to risks related to [cyber threats](#). The TRA process will identify cyber risks, assess risks' severities, and may recommend activities to reduce risks to an acceptable level.

There are different methodologies for performing TRA (e.g., Harmonized TRA Methodology^[40]), all utilize the following elements:^{[41][42][43]} identifying of assets (what should be protected), identifying and assessing of the threats and vulnerabilities for the identified assets, determining the exploitability of the vulnerabilities, determining the levels of risk associated with the vulnerabilities (what are the implications if the assets were damaged or lost), and recommending a risk mitigation program.

Megaprojects

[Megaprojects](#) (sometimes also called "major programs") are extremely large-scale investment projects, typically costing more than US\$1 billion per project. They include bridges, tunnels, highways, railways, airports, seaports, power plants, dams, wastewater projects, coastal flood protection, [oil](#) and [natural gas extraction](#) projects, public buildings, information technology systems, aerospace projects, and defence systems. Megaprojects have been shown to be particularly risky in terms of finance, safety, and social and [environmental impacts](#).

Software evolution

Studies have shown that early parts of the system development cycle such as requirements and design specifications are especially prone to error. This effect is particularly notorious in projects involving multiple [stakeholders](#) with different points of view. Evolutionary software processes offer an iterative approach to [requirement engineering](#) to alleviate the problems of uncertainty, ambiguity, and inconsistency inherent in software developments, including uncertainty, ambiguity, and inconsistency inherent in software developments.

Shipping industry

In July 2010, shipping companies agreed to use standardized procedures in order to assess risk in key shipboard operations. These procedures were implemented as part of the amended [ISM Code](#).^[44]

Underwater diving

Formal risk assessment is a required component of most [professional dive planning](#), but the format and methodology may vary. Consequences of an incident due to an identified hazard are generally chosen from a small number of standardised categories, and probability is estimated based on statistical data on the rare occasions when it is available, and on a best guess estimate based on personal experience and company policy in most cases. A simple matrix is often used to transform these inputs into a level of risk, generally expressed as unacceptable, marginal or acceptable. If unacceptable, measures must be taken to reduce the risk to an acceptable level, and the outcome of the risk assessment must be accepted by the affected parties before a dive commences. Higher levels of risk may be acceptable in special circumstances, such as military or search and rescue operations when there is a chance of recovering a survivor. [Diving supervisors](#) are trained in the procedures of [hazard identification and risk assessment](#), and it is part of their planning and operational responsibility. Both health and safety hazards must be considered. Several stages may be identified. There is risk assessment done as part of the diving project planning, on site risk assessment which takes into account the specific conditions of the day, and [dynamic risk assessment](#) which is ongoing during the operation by the members of the dive team, particularly the supervisor and the working diver.^{[45][46]}

In [recreational scuba diving](#), the extent of risk assessment expected of the diver is relatively basic and is included in the [pre-dive checks](#). Several mnemonics have been developed by [diver certification agencies](#) to remind the diver to pay some attention to risk, but the training is rudimentary. Diving service providers are expected to provide a higher level of care for their customers, and [diving instructors](#) and [divemasters](#) are expected to assess risk on behalf of their customers and warn them of site-specific hazards and the competence considered appropriate for the planned dive. Technical divers are expected to make a more thorough assessment of risk, but as they will be making an informed choice for a recreational activity, the level of acceptable risk may be considerably higher than that permitted for occupational divers under the direction of an employer.^{[47][48]}

Outdoor and wilderness adventure

In outdoor activities including commercial outdoor education, wilderness expeditions, and [outdoor recreation](#), risk assessment refers to the analysis of the probability and magnitude of unfavorable outcomes such as injury, illness, or property damage due to environmental and

related causes, compared to the human development or other benefits of outdoor activity. This is of particular importance as school programs and others weigh the benefits of youth and adult participation in various outdoor learning activities against the inherent and other hazards present in those activities. Schools, corporate entities seeking team-building experiences, parents/guardians, and others considering outdoor experiences expect or require^[49] organizations to assess the hazards and risks of different outdoor activities—such as sailing, target shooting, hunting, mountaineering, or camping—and select activities with acceptable risk profiles.

Outdoor education, wilderness adventure, and other outdoor-related organizations should, and are in some jurisdictions required, to conduct risk assessments prior to offering programs for commercial purposes.^{[50][51][52]}

Such organizations are given guidance on how to provide their risk assessments.^[53]

Risk assessments for led outdoor activities form only one component of a comprehensive risk management plan, as many risk assessments use a basic linear-style thinking that does not employ more modern risk management practice employing complex socio-technical systems theory.^{[54][55]}

Environment

Environmental Risk Assessment (ERA) aims to assess the effects of stressors, usually chemicals, on the local environment. A risk is an integrated assessment of the likelihood and severity of an undesired event. In ERA, the undesired event often depends on the chemical of interest and on the risk assessment scenario.^[56] This undesired event is usually a detrimental effect on organisms, populations or **ecosystems**. Current ERAs usually compare an exposure to a no-effect level, such as the **Predicted Environmental Concentration/Predicted No-Effect Concentration** (PEC/PNEC) ratio in Europe. Although this type of ratio is useful and often used in regulation purposes, it is only an indication of an exceeded apparent threshold.^[57] New approaches start to be developed in ERA in order to quantify this risk and to communicate effectively on it with both the managers and the general public.^[56]

Ecological risk assessment is complicated by the fact that there are many nonchemical stressors that substantially influence ecosystems, communities, and individual plants and animals, as well as across landscapes and regions.^{[58][59]} Defining the undesired (adverse) event is a political or policy judgment, further complicating applying traditional risk analysis tools to

ecological systems. Much of the policy debate surrounding ecological risk assessment is over defining precisely what is an adverse event.^[60]

Biodiversity

Biodiversity Risk Assessments evaluate risks to [biological diversity](#), specially the risk of [species extinction](#) or the risk of [ecosystem collapse](#). The units of assessments are the biological (species, [subspecies](#) or [populations](#)) or ecological entities ([habitats](#), [ecosystems](#), etc.), and the risk are often related to human actions and interventions (threats and pressures). Regional and national protocols have been proposed by multiple academic or governmental institutions and working groups,^[61] but global standards such as the [Red List of Threatened Species](#) and the [IUCN Red List of Ecosystems](#) have been widely adopted, and are recognized or proposed as official indicators of progress toward international policy targets and goals, such as the [Aichi targets](#) and the [Sustainable Development Goals](#).^{[62][63]}

See also

- [Acceptable loss](#)
- [Benefit shortfall](#)
- [Control self-assessment](#) – Technique to assess process effectiveness
- [Cost overrun](#) – Unexpected incurred costs in excess of budgeted amounts
- [Digital continuity](#)
- [Duty of care](#) – Legal standard of care in activity
- [Edwards v National Coal Board](#)
- [Extreme risk](#)
- [Environmental impact assessment](#) – Assessment of the environmental consequences of a decision before action
- [Flood risk assessment](#)
- [Form 696](#)
- [Global catastrophic risk](#) – Potentially harmful worldwide events
- [Hazard](#) – Situation or object that can cause damage or harm

- [Hazard analysis](#) – The identification of present hazards as the first step in a process to assess risk
- [Hazard analysis and critical control points \(HACCP\)](#) – Systematic preventive approach to food safety risk assessment in food
- [Health impact assessment](#)
- [Horizon scanning](#)
- [Information assurance](#)
- [Index of auditing-related articles](#)
- [ISO 28000](#) – Management system standard
- [ISO 31000](#) – Family of standards relating to risk management
- [ISSOW](#)
- [*Megaprojects and Risk*](#)
- [Network theory in risk assessment](#)
- [Occupational exposure banding](#) – Process to assign chemicals into categories corresponding to permissible exposure concentrations
- [Optimism bias](#) – Type of cognitive bias
- [PIMEX](#) a video exposure monitoring method
- [Planning fallacy](#) – Cognitive bias of underestimating time needed
- [Probabilistic risk assessment](#) – Methodology for evaluating risks
- [Probit model](#)
- [Project risk management](#)
- [Reference class forecasting](#) – Method of predicting the future
- [Reliability engineering](#) – Sub-discipline of systems engineering that emphasizes dependability
- [Risk](#) – Probability of loss of something of value
- [Risk assessment using qualifiers](#)
- [Risk-based auditing](#)
- [Risk management tools](#)

- Risk matrix
- Safety engineering – Engineering discipline which assures that engineered systems provide acceptable levels of safety
- Security risk
- Statistical risk – Statistical risk
- Strategic misrepresentation

References

Footnotes

1. Rausand M (2013). "Chapter 1: Introduction" (<https://books.google.com/books?id=9EHeLmbUVh8C&pg=PT21>) . Risk Assessment: Theory, Methods, and Applications. John Wiley & Sons. pp. 1–28. ISBN 9780470637647.
2. Manuele FA (2016). "Chapter 1: Risk Assessments: Their Significance and the Role of the Safety Professional" (<https://books.google.com/books?id=zqjLCgAAQBAJ&pg=PA2>) . In Popov G, Lyon BK, Hollcraft B (eds.). Risk Assessment: A Practical Guide to Assessing Operational Risks. John Wiley & Sons. pp. 1–22. ISBN 9781118911044.
3. Levi R (June 1, 2018). "Getting Real About Both Benefits and Risks" (<https://www.sbu.se/en/publications/medical-and-social-science--practice/getting-real-about-both-benefits-and-risks/>) . Swedish Agency of Health Technology Assessment and Assessment of Social Services. ISSN 1104-1250 (<https://www.worldcat.org/issn/1104-1250>) . Retrieved 2018-06-14 – via Science & Practice, English Special 2018 (https://www.sbu.se/contentassets/3790eb75d3a9416aa1c853d3a2abe6e7/science_practice_sbu_2018.pdf) .
External link in |via= (help)
4. Hoffmann TC, Del Mar C (February 2015). "Patients' expectations of the benefits and harms of treatments, screening, and tests: a systematic review" (http://espace.library.uq.edu.au/view/UQ:351727/UQ351727_OA.pdf) (PDF). JAMA Internal Medicine. **175** (2): 274–86. doi:10.1001/jamainternmed.2014.6016 (<https://doi.org/10.1001%2Fjamainternmed.2014.6016>) . PMID 25531451 (<https://pubmed.ncbi.nlm.nih.gov/25531451>) .
5. Stacey D, Légaré F, Lewis K, Barry MJ, Bennett CL, Eden KB, et al. (April 2017). "Decision aids for people facing health treatment or screening decisions" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6478132>) . The Cochrane Database of Systematic Reviews. **2017** (4): CD001431. doi:10.1002/14651858.CD001431.pub5 (<https://doi.org/10.1002%2F14651858.CD001431.pub5>) . PMC 6478132 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6478132>) . PMID 28402085 (<https://pubmed.ncbi.nlm.nih.gov/28402085>) .

6. Rausand M (2013). "Chapter 6: Accident Models" (<https://books.google.com/books?id=9EHeLmbUVh8C&pg=PT166>) . Risk Assessment: Theory, Methods, and Applications. John Wiley & Sons. pp. 137–76. ISBN 9780470637647.
7. Vamanu BI, Gheorghe AV, Kaina PF (2016). *Critical Infrastructures: Risk and Vulnerability Assessment in Transportation of Dangerous Goods: Transportation by Road and Rail*. Springer. p. 11. ISBN 9783319309316.
8. Lacey P (2011). "An Application of Fault Tree Analysis to the Identification and Management of Risks in Government Funded Human Service Delivery". *Proceedings of the 2nd International Conference on Public Policy and Social Sciences*. SSRN 2171117 (<https://ssrn.com/abstract=2171117>) .
9. Shirey R (August 2007). "Internet Security Glossary, Version 2" (<https://tools.ietf.org/html/rfc4949>) . Network Working Group. The IETF Trust. p. 9. Retrieved 19 July 2018.
10. Mandelbrot, Benoit and Richard L. Hudson (2008). *The (mis)Behaviour of Markets: A Fractal View of Risk, Ruin and Reward*. London: Profile Books. ISBN 9781846682629.
11. Kasperson RE, Renn O, Slovic P, Brown HS, Emel J, Goble R, Kasperson JX, Ratick S (1988). "The social amplification of risk: A conceptual framework" (http://elib.uni-stuttgart.de/bitstream/11682/7238/1/re_n27.pdf) (PDF). *Risk Analysis*. **8** (2): 177–187. doi:10.1111/j.1539-6924.1988.tb01168.x (<https://doi.org/10.1111%2Fj.1539-6924.1988.tb01168.x>) .
12. Commoner, Barry. O'Brien, Mary. Shrader-Frechette and Westra 1997.
13. Taleb NN (September 2008). *The fourth quadrant: a map of the limits of statistics* (http://homepage.sns.it/hosni/lori/intranet/readings/Edge_the_fourth_quadrant_map_limits_of_statistics.pdf) (PDF). An Edge original essay (Report).
14. Holzmann R, Jørgensen S (2001). "Social Risk Management: A New Conceptual Framework for Social Protection, and Beyond". *International Tax and Public Finance*. **8** (4): 529–56. doi:10.1023/A:1011247814590 (<https://doi.org/10.1023%2FA%3A1011247814590>) . S2CID 14180040 (<https://api.semanticscholar.org/CorpusID:14180040>) .
15. Nakaš N (21 November 2017). "Three Lessons About Risk Management from Everyday Life" (<http://knowledgehub.cef-see.org/?p=1399>) . Knowledge Hub. Center of Excellence in Finance. Retrieved 19 July 2018.
16. Lock G (June 2017). Phillips M (ed.). "Public Safety Diving-Dynamic Risk Assessment" (http://psdiver.com/images/PSDiver_Issue_116_-_SECURE.pdf) (PDF). *PS Diver Magazine* (116): 9. Retrieved 20 June 2017.
17. UNDRR (2019). *Global Assessment Report on Disaster Risk Reduction* (<https://gar.unisdr.org>) . Geneva: UNDRR. p. 472. ISBN 978-92-1-004180-5. Retrieved 22 June 2020.

18. Tiepolo M (2019). "Flood Assessment for Risk-Informed Planning along the Sirba River, Niger" (<https://doi.org/10.3390%2Fw11051018>) . *Sustainability*. **11** (4003). doi:10.3390/w11051018 (<https://doi.org/10.3390%2Fw11051018>) .
19. Massazza G (2019). "Flood Hazard Scenarios of the Sirba River (Niger): Evaluation of the Hazard Thresholds and Flooding Areas" (<https://doi.org/10.3390%2Fw11051018>) . *Water*. **11** (5): 1018. doi:10.3390/w11051018 (<https://doi.org/10.3390%2Fw11051018>) .
20. Tiepolo M (2018). "Multihazard Risk Assessment for Planning with Climate in the Dosso Region, Niger" (<https://doi.org/10.3390%2Fcli6030067>) . *Climate*. **6** (67): 67. doi:10.3390/cli6030067 (<https://doi.org/10.3390%2Fcli6030067>) .
21. International Organization for Standardization. "ISO Guide 73: 2009. Risk management – Vocabulary" (<https://www.iso.org/standard/44651.html>) . ISO. ISO. Retrieved 22 June 2020.
22. Tarchiani V (2020). "Community and Impact Based Early Warning System for Flood Risk Preparedness: The Experience of the Sirba River in Niger" (<https://doi.org/10.3390%2Fsu12062196>) . *Sustainability*. **12** (2196). doi:10.3390/su12062196 (<https://doi.org/10.3390%2Fsu12062196>) .
23. Tiepolo M (2020). "Mainstreaming Disaster Risk Reduction into Local Development Plans for Rural Tropical Africa: A Systematic Assessment" (<https://doi.org/10.3390%2Fsu12062196>) . *Sustainability*. **12** (2196): 2196. doi:10.3390/su12062196 (<https://doi.org/10.3390%2Fsu12062196>) .
24. "Risk Assessment and Regulation Information from the NLM" (<http://sis.nlm.nih.gov/enviro/riskinformation.html>) . NLM. Retrieved 9 June 2013.
25. "Databases on toxicology, hazardous chemicals, environmental health, and toxic releases" (<http://toxnet.nlm.nih.gov>) . TOXNET. NLM. May 2012. Retrieved 9 June 2013.
26. "Household Products Database" (<http://hpd.nlm.nih.gov/>) . U.S. Dept. of Health & Human Services. January 2013. Retrieved 9 June 2013.
27. "Risk Assessment Portal" (<http://www.epa.gov/risk/>) . EPA. 13 May 2013. Retrieved 9 June 2013.
28. EPA Alumni Association: Senior EPA officials discuss early implementation of the Safe Drinking Water Act of 1974, Video (<http://www.epaalumni.org/history/video/interview.cfm?id=13>) , Transcript (<http://www.epaalumni.org/userdata/pdf/6014106B36AE81EB.pdf#page=11>) (see pages 11,14).
29. "Risk Assessment" (<http://www.epa.gov/risk/>) . www.epa.gov. US Environmental Protection Agency. 2013-09-26. Retrieved 2016-04-07.
30. Szabo DT, Loccisano AE (March 30, 2012). "POPs and Human Health Risk Assessment". *Dioxins and Persistent Organic Pollutants* (3rd ed.). pp. 579–618. doi:10.1002/9781118184141.ch19 (<https://doi.org/10.1002%2F9781118184141.ch19>) . ISBN 9781118184141.

31. R. Shirey (August 2007). *Internet Security Glossary, Version 2* (<https://datatracker.ietf.org/doc/html/rfc4949>) . Network Working Group. doi:10.17487/RFC4949 (<https://doi.org/10.17487%2FRFC4949>) . RFC 4949 (<https://datatracker.ietf.org/doc/html/rfc4949>) .
32. Hunter PR, Fewtrell L (2001). "Acceptable Risk" (https://www.who.int/water_sanitation_health/dwq/iwachap10.pdf) (PDF). World Health Organization.
33. Merrill RA (1997). "Food safety regulation: reforming the Delaney Clause" (<https://doi.org/10.1146%2Fannurev.publhealth.18.1.313>) . *Annual Review of Public Health*. **18**: 313–40. doi:10.1146/annurev.publhealth.18.1.313 (<https://doi.org/10.1146%2Fannurev.publhealth.18.1.313>) . PMID 9143722 (<https://pubmed.ncbi.nlm.nih.gov/9143722>) . This source includes a useful historical survey of prior food safety regulation.
34. *Current intelligence bulletin 69: NIOSH practices in occupational risk assessment* (<https://www.cdc.gov/niosh/docs/2020-106/>) (Report). 2020-02-01. doi:10.26616/nioshpub2020106 (<https://doi.org/10.26616%2Fnioshpub2020106>) .
35. "OSHA's 5 Workplace Hazards" (<http://www.grainger.com/know-how/safety/safety-management/safety-compliance/kh-five-workplace-hazards>) . Grainger Industrial Supply.
36. Waters M, McKernan L, Maier A, Jayjock M, Schaeffer V, Brosseau L (2015-11-25). "Exposure Estimation and Interpretation of Occupational Risk: Enhanced Information for the Occupational Risk Manager" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685553>) . *Journal of Occupational and Environmental Hygiene*. **12** (Suppl 1): S99-111. doi:10.1080/15459624.2015.1084421 (<https://doi.org/10.1080%2F15459624.2015.1084421>) . PMC 4685553 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685553>) . PMID 26302336 (<https://pubmed.ncbi.nlm.nih.gov/26302336>) .
37. *Managing Project Risks* (<http://www.pmhut.com/managing-project-risks>) - Retrieved May 20th, 2010
38. Spring J, Kern S, Summers A (2015-05-01). "Global adversarial capability modeling". 2015 APWG Symposium on Electronic Crime Research (eCrime). pp. 1–21. doi:10.1109/ECRIME.2015.7120797 (<https://doi.org/10.1109%2FECRIME.2015.7120797>) . ISBN 978-1-4799-8909-6. S2CID 24580989 (<https://api.semanticscholar.org/CorpusID:24580989>) .
39. "NIST COMPUTER SECURITY RESOURCE CENTER Glossary" (https://csrc.nist.gov/glossary/term/risk_assessment) .
40. Security, Canadian Centre for Cyber (2018-08-15). "Canadian Centre for Cyber Security" (<https://cyber.gc.ca/en/guidance/harmonized-tra-methodology-tra-1>) . Canadian Centre for Cyber Security. Retrieved 2021-08-09.

41. Baingo, Darek (2021), Masys, Anthony J. (ed.), "Threat Risk Assessment (TRA) for Physical Security" (http://doi.org/10.1007/978-3-030-71998-2_14) , Sensemaking for Security, Advanced Sciences and Technologies for Security Applications, Cham: Springer International Publishing, pp. 243–270, doi:10.1007/978-3-030-71998-2_14 (https://doi.org/10.1007%2F978-3-030-71998-2_14) , ISBN 978-3-030-71998-2, S2CID 236706551 (<https://api.semanticscholar.org/CorpusID:236706551>) , retrieved 2021-08-09
42. "An Overview of Threat and Risk Assessment | SANS Institute" (<https://www.sans.org/white-papers/76/>) . www.sans.org. Retrieved 2021-08-09.
43. Secretariat, Treasury Board of Canada (2006-03-06). "Rescinded [2019-06-28] - Security Organization and Administration Standard" (<https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12333>) . www.tbs-sct.gc.ca. Retrieved 2021-08-09.
44. "ISM CODE – Amendments from 1st July 2010 Risk Assessment" (http://www1.veristar.com/veristar/dps_info.nsf/veristar/Dps_info.nsf/AllByDateInternal/353FC02A22D59873C1257734003EC51C?opendocument) .
45. "Diving Regulations 2009" (https://web.archive.org/web/20161104080007/http://www.saflii.org/za/legis/consol_reg/ohasa85o1993rangnr41716/) . Occupational Health and Safety Act 85 of 1993 – Regulations and Notices – Government Notice R41. Pretoria: Government Printer. Archived from the original (http://www.saflii.org/za/legis/consol_reg/ohasa85o1993rangnr41716/) on 4 November 2016. Retrieved 3 November 2016 – via Southern African Legal Information Institute.
46. Staff (August 2016). "15 - General safety requirements". Guidance for diving supervisors IMCA D 022 (Revision 1 ed.). London, UK: International Marine Contractors Association. pp. 15–5.
47. Staff (1977). "The Diving at Work Regulations 1997" (<http://www.legislation.gov.uk/uksi/1997/2776/made>) . Statutory Instruments 1997 No. 2776 Health and Safety. Kew, Richmond, Surrey: Her Majesty's Stationery Office (HMSO). Retrieved 6 November 2016.
48. Gurr K (August 2008). "13: Operational Safety". In Mount T, Dituri J (eds.). Exploration and Mixed Gas Diving Encyclopedia (1st ed.). Miami Shores, Florida: International Association of Nitrox Divers. pp. 165–180. ISBN 978-0-915539-10-9.
49. "2018 Accreditation Rubric" (https://www.nwais.org/uploaded/accreditation_resources/2018_Membership_AccredRubric.pdf) (PDF). Seattle, Washington: Northwest Association of Independent Schools.
50. "Adventure Activities Regulations" (<http://www.supportadventure.co.nz/adventure-activities-regulations>) . supportadventure.co.nz.
51. "Health and Safety at Work (Adventure Activities) Regulations 2016 (LI 2016/19)" (<http://www.legislation.govt.nz/regulation/public/2016/0019/latest/DLM6725703.html>) . New Zealand Legislation.
52. "Adventure Activities Licensing" (<http://www.hse.gov.uk/aala/>) . The Health and Safety Executive (HSE). gov.uk.

53. "Adventure activities" (<https://worksafe.govt.nz/topic-and-industry/adventure-activities>) . Work Safe. New Zealand.
54. Dallat, Clare; Salmon, Paul M.; Goode, Natassia (2015). "All about the Teacher, the Rain and the Backpack: The Lack of a Systems Approach to Risk Assessment in School Outdoor Education Programs" (<https://linkinghub.elsevier.com/retrieve/pii/S2351978915001948>) . *Procedia Manufacturing*. **3**: 1157–1164. doi:10.1016/j.promfg.2015.07.193 (<https://doi.org/10.1016%2Fj.promfg.2015.07.193>) .
55. Baierlein, Jeff (2019). *Risk Management for Outdoor Programs: a Guide to Safety in Outdoor Education, Recreation and Adventure* (<https://www.viristar.com/book>) . Seattle, WA: Viristar LLC.
56. Goussen B, Price OR, Rendal C, Ashauer R (October 2016). "Integrated presentation of ecological risk from multiple stressors" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5080554>) . *Scientific Reports*. **6**: 36004. Bibcode:2016NatSR...636004G (<https://ui.adsabs.harvard.edu/abs/2016NatSR...636004G>) . doi:10.1038/srep36004 (<https://doi.org/10.1038%2Fsrep36004>) . PMC 5080554 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5080554>) . PMID 27782171 (<https://pubmed.ncbi.nlm.nih.gov/27782171>) .
57. Jager T, Heugens EH, Kooijman SA (April 2006). "Making sense of ecotoxicological test results: towards application of process-based models". *Ecotoxicology*. **15** (3): 305–14. CiteSeerX 10.1.1.453.1811 (<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.453.1811>) . doi:10.1007/s10646-006-0060-x (<https://doi.org/10.1007%2Fs10646-006-0060-x>) . PMID 16739032 (<https://pubmed.ncbi.nlm.nih.gov/16739032>) . S2CID 18825042 (<https://api.semanticscholar.org/CorpusID:18825042>) .
58. Goussen, B; Rendal, C; Sheffield, D; Butler, E; Price, O. R.; Ashauer, R (December 2020). "Bioenergetics modelling to analyse and predict the joint effects of multiple stressors: Meta-analysis and model corroboration" (<https://doi.org/10.1016%2Fj.scitotenv.2020.141509>) . *Science of the Total Environment*. **749**: 141509. arXiv:2102.13107 (<https://arxiv.org/abs/2102.13107>) . Bibcode:2020ScTEen.749n1509G (<https://ui.adsabs.harvard.edu/abs/2020ScTEen.749n1509G>) . doi:10.1016/j.scitotenv.2020.141509 (<https://doi.org/10.1016%2Fj.scitotenv.2020.141509>) . PMID 32827825 (<https://pubmed.ncbi.nlm.nih.gov/32827825>) .
59. Landis WG (2005). *Regional scale ecological risk assessment : using the relative risk model*. Boca Raton, FL: CRC Press. ISBN 1-56670-655-6. OCLC 74274833 (<https://www.worldcat.org/oclc/74274833>) .
60. Lackey R (1997). "If ecological risk assessment is the answer, what is the question". *Human and Ecological Risk Assessment*. **3** (6): 921–928. doi:10.1080/10807039709383735 (<https://doi.org/10.1080%2F10807039709383735>) .
61. Nicholson E, Regan TJ, Auld TD, Burns EL, Chisholm LA, English V, et al. (2015). "Towards consistency, rigour and compatibility of risk assessments for ecosystems and ecological communities". *Austral Ecology*. **40** (4): 347–363. doi:10.1111/aec.12148 (<https://doi.org/10.1111%2Faec.12148>) . hdl:1885/66771 (<https://hdl.handle.net/1885%2F66771>) . ISSN 1442-9985 (<https://www.worldcat.org/issn/1442-9985>) . S2CID 82412136 (<https://api.semanticscholar.org/CorpusID:82412136>) .

62. Keith DA, Rodríguez JP, Brooks TM, Burgman MA, Barrow EG, Bland L, et al. (2015). "The IUCN Red List of Ecosystems: Motivations, Challenges, and Applications" (<https://doi.org/10.1111%2Fconl.12167>) . Conservation Letters. **8** (3): 214–226. doi:10.1111/conl.12167 (<https://doi.org/10.1111%2Fconl.12167>) . ISSN 1755-263X (<https://www.worldcat.org/issn/1755-263X>) .
63. Brooks TM, Butchart SH, Cox NA, Heath M, Hilton-Taylor C, Hoffmann M, et al. (2015). "Harnessing biodiversity and conservation knowledge products to track the Aichi Targets and Sustainable Development Goals" (<https://doi.org/10.1080%2F14888386.2015.1075903>) . Biodiversity. **16** (2–3): 157–174. doi:10.1080/14888386.2015.1075903 (<https://doi.org/10.1080%2F14888386.2015.1075903>) . ISSN 1488-8386 (<https://www.worldcat.org/issn/1488-8386>) .

General references

- Dorne JC, Kass GE, Bordajandi LR, Amzal B, Bertelsen U, Castoldi AF, Heppner C, Eskola M, Fabiansson S, Ferrari P, Scaravelli E, Dogliotti E, Fuerst P, Boobis AR, Verger P (2011). "Chapter 2. Human Risk Assessment of Heavy Metals: Principles and Applications". In Sigel A, Sigel H, Sigel RK (eds.). *Metal Ions in Toxicology*. Metal Ions in Life Sciences. RSC Publishing. pp. 27–60. doi:10.1039/9781849732116-00027 (<https://doi.org/10.1039%2F9781849732116-00027>) . ISBN 978-1-84973-091-4. S2CID 24530234 (<https://api.semanticscholar.org/CorpusID:24530234>) .
- Mumtaz MM, Hansen H, Pohl HR (2011). "Chapter 3. Mixtures and Their Risk Assessment in Toxicology". In Sigel A, Sigel H, Sigel RK (eds.). *Metal Ions in Toxicology*. Metal Ions in Life Sciences. RSC Publishing. pp. 61–80. doi:10.1039/9781849732116-00061 (<https://doi.org/10.1039%2F9781849732116-00061>) . ISBN 978-1-84973-091-4.
- Committee on Risk Assessment of Hazardous Air Pollutants (1994), *Science and judgment in risk assessment* (<https://books.google.com/books?id=k9mKUyfHakcC&q=Science+and+judgment+in+risk+assessment>) , Washington, D.C: National Academy Press, ISBN 978-0-309-04894-1, retrieved 27 September 2010
- Commoner B. "Comparing apples to oranges: Risk of cost/benefit analysis". In Iannone AP (ed.). *Contemporary moral controversies in technology*. pp. 64–65.
- Hallenbeck WH (1986). *Quantitative risk assessment for environmental and occupational health*. Chelsea, Mich.: Lewis Publishers.
- Harremoës P (ed.). *Late lessons from early warnings: the precautionary principle 1896–2000*.
- Lachin JM. *Biostatistical methods: the assessment of relative risks*.
- Lerche I, Glaesser W (2006). *Environmental risk assessment : quantitative measures, anthropogenic influences, human impact* (https://books.google.com/books?id=qB54qgpA_fEC&q=Environmental+risk+assessment) . Berlin: Springer. ISBN 978-3-540-26249-7. Retrieved 27 September 2010.

- Kluger J (November 26, 2006). "How Americans Are Living Dangerously" (<https://web.archive.org/web/20061127232613/http://www.time.com/time/magazine/article/0,9171,1562978,00.html>) . *Time*. Archived from the original (<http://www.time.com/time/magazine/article/0,9171,1562978,00.html>) on November 27, 2006. Retrieved 27 September 2010. Also published as December 4 cover title: "Why We Worry About the Wrong Things: The Psychology of Risk" (<https://web.archive.org/web/20061206030428/http://www.time.com/time/magazine/0%2C9263%2C7601061204%2C00.html>) |work=Time
- A Review of risk assessment methodologies (Report). Washington: U.S: [Congressional Research Service](#), Library of Congress, for the Subcommittee on Science, Research, and Technology. 1983.
- O'Brien M (2002). *Making better environmental decisions: an alternative to risk assessment* (<https://books.google.com/books?id=LtCOEN9HWlC&q=Making+better+environmental>) . Cambridge, Massachusetts: MIT Press. ISBN 0-262-65053-3. Retrieved 27 September 2010.
- Mayo DG (1997). "Sociological versus metascientific views of technological risk assessment". In Shrader-Frechette K, Westra L (eds.). *Technology and values* (<https://books.google.com/books?id=y5BfvU6uMQM&q=Technology+and+values>) . Lanham, Maryland: Rowman & Littlefield. ISBN 978-0-8476-8631-5. Retrieved 27 September 2010.
- Rozell DJ (2020). *Dangerous Science: Science Policy and Risk Analysis for Scientists and Engineers*. London: Ubiquity Press. doi:10.5334/bci (<https://doi.org/10.5334%2Fbci>) . ISBN 978-1-911529-90-3. S2CID 213952232 (<https://api.semanticscholar.org/CorpusID:213952232>) .

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