



Ethics and fundamental principles of risk acceptance criteria

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ABSTRACT

Ethics are concerned with distinguishing between what actions are “right” and “wrong” and what values are “good” and “bad”, etc. and there is a long academic tradition in discussing ethics and ethical theories. Risk acceptance criteria, on the other hand, distinguish between levels of risks that are acceptable and levels that are intolerable. In some sense, one may say that risk acceptance criteria distinguishes between “good” and “bad” systems and activities with regards to the risk they expose the society or elements of a society to and there is thus an obvious link between ethics and risk acceptance criteria or to risk management at large. However, there are few references in the literature that explores this link, and in this paper, the ethical foundation of fundamental principles of risk acceptance criteria will be elaborated upon.

This paper considers some important principles for establishing risk acceptance criteria for safety critical systems and activities. The various principles and the philosophies behind them might at first sight seem contradictory and exclusive, but it is demonstrated how they may coexist in one and the same regulatory regime; They may complement each other in order to achieve the overall safety objectives of society. Then, some brief considerations of the ethical foundations for the principles will be given and some relevant examples of actual risk acceptance criteria will be given from the maritime industries. However, it is believed that the principles and discussions are of general interest and apply to all areas of technical risk and to safety regulations in a broader perspective.

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1. Introduction and background

Nearly all activities in life involve risk in some way or another, and there are no universally agreed criteria for what levels of risk are acceptable. Identified and unidentified risks are always sought to be controlled and minimized. The most commonly used strategy for managing risk in the public interest is through legislation and regulation, although everyone is constantly voluntarily managing personal risk in daily life on an individual level, both consciously as well as unconsciously.

Risk reduction will come at a price and there will be a trade-off between the level of risk one accepts and the cost one is willing to spend to mitigate it. For decision-makers responsible for public safety, at the expense of the public wealth, this trade-off needs to be considered carefully and thoroughly. Also the varying needs of different stakeholders must be balanced. The overall objective is to best allocate the society's scarce resources for risk reduction, by supporting the implementation of efficient risk reduction measures and to avoid wasting efforts on inefficient ones.

Risks introduced to the society from a given activity may be of different types. Fatality risks or health risks are the risk of depriving members of the community of their lives or their good health.

Other types are property risk, economic risk and environmental risks. When decisions about safety are made, all risks should be considered, and appropriate acceptance criteria for fatality, health, environmental, economic and property risks should all be met before an activity can be declared safe enough (Jonkman et al., 2003). However, this paper focuses on safety risk.

Safety is surely an important objective in society, but it is not the only one and allocation of resources on safety must be balanced with that of other societal needs. In the literature, different fundamental principles for appropriate risk acceptance criteria have been proposed (see e.g. Nathwani et al., 2009) and extensive research is continuously going on; new principles for establishing and evaluating criteria are continually being introduced. For example, in BRTF (2003), the following five principles for good regulation are established: Proportionality, Accountability, Consistency, Transparency and Targeting. Reference is also made to Aven (2003). As a consequence, new risk acceptance criteria are frequently proposed (see e.g. Moseman, 2011). Risk acceptance criteria will obviously depend on the legal framework of the society and different legal frameworks might yield different criteria (Hartford, 2009). A comparison of risk regulation in two European countries, the UK and the Netherlands, is presented in Ale (2005) and it is shown that even though the legal and historical context is different, the risk acceptance criteria and the levels of risk are very similar.

At any rate, the establishment of various risk acceptance criteria is one approach for managing risk on behalf of the public, even

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though it is acknowledged that there have been expressed some objections to the use of risk acceptance criteria and that other alternatives exist (Aven and Vinnem, 2005; Abrahamsen and Aven, 2008). However, Vinnem (2010) argues that risk acceptance criteria are superior to risk-informed decision making in some contexts, and also suggests that there should be regulations stating how risk acceptance criteria should be formulated. Meyer et al. (2007) also express the view that defining risk acceptance criteria is a good practice for risk management.

Having adopted a set of fundamental principles to govern the establishment of risk acceptance criteria, specific risk acceptance criteria can be formulated. In this paper, some important principles for establishing risk acceptance criteria are presented and discussed. At first sight, some of these may seem exclusive but it will be demonstrated how the different principles can be employed to complement each other in one and the same regulatory regime. Brief considerations on the ethical foundations of the various principles will also be given and it is argued that there is a close link between ethics and risk management and also that it will be fruitful to make ethical considerations and reflections when establishing risk acceptance criteria. Ethical justification for the principles behind risk acceptance criteria may be found in both deontological and teleological ethics. However, it is out of scope to try to evaluate and compare the ethical position of different regulatory regimes, as discussed in Aven (2007). Some examples of actual risk acceptance criteria will be given from the maritime industries, but the principles and discussions are believed to be general enough to apply to all areas of technical risk. An abbreviated version of this paper was presented at the ESREL 2011 conference (Vanem, 2011).

2. Individual and societal risk acceptance criteria

Depending on the system under consideration, both individual and societal risk acceptance criteria might apply. For large systems exposing a large number of people to risks, and where a large number of people are affected by possible accidents, societal risk acceptance criteria are deemed to be most appropriate. In general, societal risk are expressed in terms of frequency versus number of fatalities, and two of the most commonly used methods of describing such risks are risk matrices or FN-curves. In an FN-diagram the number of fatalities, N , is plotted against the frequency of events with N or more fatalities, F , and gives an illustration of the estimated risk, e.g. as a result of a risk analysis. Risk matrices can be considered as a discrete version of an FN-curve and usually divides the frequencies and severities into a few categories. Fig. 1 shows an example of risk acceptance criteria expressed by way of a risk matrix. An FN-diagram with criterion lines representing risk acceptance criteria is shown in Fig. 2. Potential Loss of Lives (PLLs) is another measure of societal risk for a defined system or activity. Societal concern is a related concept to societal risk that is somewhat wider in scope, including e.g. consequences such as lack of trust in the government and other impacts on society. Societal risk is considered to be a subset of societal concern (HSE, 2002a,b).

| | | | | |
|---------------------------|------------------------|--|--|--|
| Probability of occurrence | | | | |
| | | | | |
| | | | | |
| | Consequence - severity | | | |

Fig. 1. Examples of societal risk acceptance criteria expressed in a risk matrix.

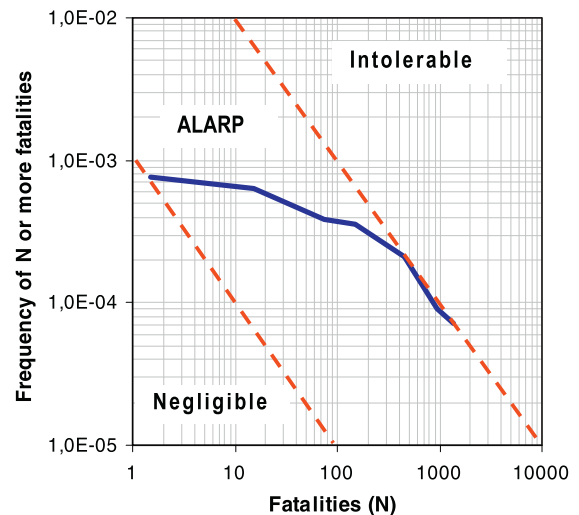


Fig. 2. An FN diagram with criterion lines representing absolute values for intolerable and negligible risks and an ALARP area in between where cost-effectiveness criteria apply.

On the other hand, if identified individuals or a group of individuals are exposed to additional risks, criteria based on individual risk are most appropriate. When individual risks are discussed, it will often be suitable to consider an exposed user, i.e. an imaginary person that is especially exposed to the hazards imposed by the system. The individual risks consist of risks of death, injuries and ill health, and the level of risk will be described by the probability of such outcomes per some appropriate measure of exposure, e.g. year, work-hours, travelled distances, etc. Individual risk acceptance criteria will determine the limits between acceptable and unacceptable probabilities of accidents causing death, injuries or ill health. Factors such as voluntariness, direct benefit and degree of control influence what level of risk are regarded as acceptable, and it may therefore be distinguished between acceptable risks for e.g. workers (Rimington et al., 2003) and third parties.

For complex systems, risks will often be introduced to the general public as well as to a special group of individuals, typically workers or nearby residents, and both criteria for societal risk and individual risk will have to be complied with. Often, special consideration is given to the risk of events with low frequency but high severity, as addressed in Henselwood and Phillips (2009).

3. Principles for establishing risk acceptance criteria

Various principles can be employed when deriving and establishing appropriate values for risk acceptance criteria for use in risk management, decision-making and safety regulation. The adopted principles will naturally influence the criteria arrived at. Furthermore, by applying some fundamental principles, it may be ensured that the risk acceptance criteria are based on a sound rationale and that they may easily be justified in a transparent manner. It may also facilitate high-level discussions on risk acceptance by discussing the underlying principles, and the actual criteria can be derived based on agreed principles.

3.1. Absolute risk criteria

This principle for establishing risk acceptance criteria does not consider the cost associated with achieving the corresponding risk level. Only the level of risk itself is studied and the risk criteria will be formulated as a maximum level of risk that is not to be exceeded, without any regard to the cost and benefit associated with

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