

# COMPARABILITY OF RISK

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## INTRODUCTION

The concept "risk" means different things to different people. When technocrats judge risk in their field of expertise, their responses correlate highly with quantitative estimates of probabilities. However, judgements and interpretations by non-experts attach much more importance to cognitive dimensions of perception. Risk evaluation by quantitative risk assessments or by risk perception should not be regarded as competitive but as complementary.

## CONCEPT OF RISK

A great deal of discussion is often devoted to formulating "a proper definition of risk". Literature shows that there is an enormous variety of definitions and interpretations [2, 3, 5, 6, 8]. In health related sciences "risk" is often addressed as a multi dimensional combination of harmful health effects and their probabilities. In technological safety analysis, "risk" usually is expressed as a mathematical representation of probabilities of undesired events. In non-technology related sciences, interpretations are close to the loose meaning in every day language, referring to the threat of undesired events or the dread of harmful consequences. These different interpretations of risk cause considerable confusion in risk communication.

Quantitative definitions for any risk parameter in assessment studies should fulfil the conceptual requirement that they provide information about the basic triplet of risk components: scenario, probability and consequences [3].

- The "scenario" identification refers to the question "what can happen or what can go wrong?".
- The "probability" issue which refers to the question "how likely is it that things will happen?".
- The description of "consequences or measures of damage, which should answer the question "if it does happen, what are the consequences?".

The complexity of such a concept, especially because of each of these three components is of a multi dimensional nature in itself, leads to the necessity of simplification. Any definition of risk is conceptually adequate as long as it addresses all three fundamental components. Otherwise risk assessment or risk evaluation is impossible.

## REDUCTION OF COMPLEXITY

It is a trivial statement that reduction of complexity of reality goes hand in hand with simplification. This is legitimate, because it is a necessary requirement to manage the complexity of risk assessments. However, one must realize that each step of simplification incorporates choices, value judgements or even policy judgements.

TYPOLOGY OF RISK DEFINITIONS [2]	TYPOLOGY OF COGNITIVE RISK DIMENSIONS [2,4]
<ol style="list-style-type: none"> <li>1. Uncertainty about safety or health</li> <li>2. Possibility of undesired consequences (loss, damage, injury, death)</li> <li>3. Lack of perceived controllability of a practice</li> <li>4. Conditional probability - (mathematical expectation) - of a single type of harm (or loss)</li> <li>5. Frequentistic presentation of a mono-dimensional index of harm</li> <li>6. Multi attributive weighted aggregate of probabilities and consequences (utility theory)</li> <li>7. Multi dimensional presentation of probabilities and consequences</li> </ol>	<ol style="list-style-type: none"> <li>1. Character and severity of harm or consequence</li> <li>2. Controllability and influencibility by prevention and mitigation</li> <li>3. Number of population at risk</li> <li>4. Familiarity with consequences or activities</li> <li>5. Voluntariness, intentionality and degree of involvement</li> <li>6. Persistence, delay and transgenerational aspects</li> </ol>

Any choice of definition and any choice of methodology in risk assessment is influenced by cultural, professional, institutional or even policy considerations. For this reasons Fischhoff [5] calls the choice for definition "a political act", which like any other choice in policy issues is inherently controversial. The choice of a risk parameter and the choice of methodology influences the outcome of any analysis and subsequently also influences conclusions and decisions. This is not meant as a criticism, but as a warning. Many risk analysts pretend that quantitative risk assessment is objective. This in my view, is not correct. Because even the choice of a risk definition or quantity is a value judgement in itself. There exists no dichotomy between subjective or objective risk evaluations. What does exist is a distinction between (i) quantitative risk assessment methodologies which assign preferential choices to the use of quantifiable parameters as simplified representations of risk and (ii) qualitative socio-psychologic methodologies which predominantly address the cognitive dimensions of risk perception. It is a matter of fact, proven by extensive psychological research that qualitative risk perception is generally uncorrelated with quantitative risk assessments [1, 2, 4, 5].

## QUANTIFICATION

In quantitative risk assessments, the complex nature of risk is reduced by the choice of a highly simplified risk parameter. The ultimate simplification is reflected in probability assessments where only one single component of health detriment or harm is taken into account. Proponents of such simplified approach, especially amongst technocrats and policy makers, argue nevertheless that such a single dimensional "yard stick" of risk is suitable for policy decisions, because they assume such risk quantity is measurable. Most of these focus on mathematical representations for probability. The underlying assumption is of a typical technocratic nature. It is assumed that interpretation and comparison of numbers is more objective than any qualitative approach. What I wish to stress here, is that any choice of a quantifiable parameter to characterize only a few or even one single isolated aspect of risk, involves subjective judgement and therefore puts restrictions on the utility and significance of such quantitative risk estimates.

Further it must be realized that the probability aspect of risk in itself is of a multi dimensional nature. Distinction must be made between the "stochastic" probability of occurrence of hazardous events, the "frequentistic" probabilities that such events will lead to exposure and further the "conditional" probability that such exposure may result in harmful consequences. Technocrats sometimes seem to forget that probability does not merely refer to frequency, but that it also reflects subjective probability aspects by "best estimates" and "expert judgements". This variety of interpretations of probability implies a warning against aggregation into a single "probability estimate".

## CETERIS PARIBUS

Interpretation and comparison of quantitative risk estimates become meaningless or even misleading when it is not guaranteed that respective practices or situations are otherwise comparable. This so called "ceteris paribus" principle requires that all factors, circumstances and assumptions that are not explicitated in the outcome of risk quantification, shall be mutually equivalent. This means that all technological, physical, biological and social descriptors shall not be essentially different. This "ceteris paribus" principle implies that quantified probability estimates must regard the same type of consequences as well as the same nature of scenarios. The required equivalence of consequences is a very restrictive constraint to the comparability of probabilities, because there exists not only a large variety of essentially different consequences, but each of them has widely different arguments. Even when only health detriment is considered, there still remains a variety of components.

Well-known examples of (apparently) single dimensional risk quantities are (a) fatal accident frequency rate - FAFR, (b) frequency of death per person year, (c) unicohort and (d) loss of life expectancy. Each separately these quantities provide an extremely narrow and biased view on risk. For this reason they are hardly intercomparable. Covello et al. [8] emphasize this by explicit warning that "use of such data for risk comparison purposes can severely damage your credibility".

The multidimensional character of damage and harm shows somewhat better in multi attribute utility techniques. There risk is defined as a weighted combination of value judgements over the various attributes of harm. This can be described as a vector presentation in which each element or dimension represents a quantifiable attribute, such as probabilities and magnitude of consequences. The overall risk is then evaluated as the weighted sum of scores on different attributes. It seems often forgotten that such quantitative approach can be highly sensitive to small variations in weighting factors or the choice of attributes [5].

## PERCEPTION

The limited comparability of quantitative risk estimates has clearly emerged in psychological research on risk evaluation. The impact of so called cognitive dimensions of risk, is apparent. Such descriptors are of a physical, biological and social character. The typology of cognitive dimensions is more of an effect related nature [2, 4, 7] and includes (i) the threat to biosphere, (ii) the threat to human health, (iii) the catastrophic nature of consequences, (iv) the intentionality and voluntariness of risk, (v) the distribution in time and space.

The major conclusion from psychological surveys is that people do not deal with risks in a consistent manner. The main arguments of the apparent great variety in risk perception and risk judgements are reasonably well-understood [1, 2, 7]. There exist a variety of mutually incommensurable, unequal interpretations and notions of the concept of risk and the extent of the problem analysis. Public perceptions of risk differ from assessments by experts. What is even more important is to recognize that perceptions can seem indifferent to risk communication. Additionally there are two other issues of main importance. At first, there is the issue of "equity". This involves problems about the fairness with regard to unequal distribution of benefits on one hand and cost and risk of a practice on the other hand. Further there is the issue of individual and collective partiality. Prejudice, with regard to the nature of the practice or situation as well as with regard to the type of harm or consequences. Especially where it involves large scale practices and low-probability - high-consequence type of activities, social political views and selective preferences are so extremely dominant that they cannot be implied in risk assessment methodology. Decision making then requires procedures which pay utmost care to social balance and acceptance. The role of risk comparison and risk assessment in such decision making processes is very limited, if at all existent.

## CONCLUSION

The issue of comparability of risk is dominated by the following issues:

- the choice of definition; technocratic quantitative interpretations of risk are not by definitions objective. Any simplified risk definition implies value judgements.
- the scope of the problem; comparison of partial components of risk is more meaningful than presentation of absolute numbers. The pursuit of a unified, one dimensional risk quantity is unrealistic. It is a misjudgement of the gap between technocratic risk assessment and public risk acceptance.
- the "ceteris paribus" principle is an essential requirement for any risk comparison; the required equivalence of conditions is a very restrictive constraint to the comparability of numerical estimates.
- risk quantification and risk perception are uncorrelated; it is a requirement for risk management and risk regulation to imply both components in the structure of decision making. Risk quantification is predominantly a source or practice related assessment, while risk perception is highly consequence and effect related. They both rely on implicit value judgements. Explication of such hidden dimensions of risk is an essential requirement for comparability.

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