

# RISK ANALYSIS SERIES

## PART ONE - WHY RISK ANALYSIS?

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*The goal of this paper is to introduce the reader to the Risk Analysis Series to be developed in the pages of the Journal of Defense Resources Management. Risk analysis is of outmost importance in dealing with resource allocation and this is the reason the paper's author started this series. Different views and approaches will be added during further discussion about risk analysis so that the reader develops a habit or skills of dealing with this intricate and challenging field.*

**Key words:** risk analysis, evolution, philosophy

There is a need for a general and thorough approach to justifying, explaining, demonstrating, working, sampling, using, creating real skills in Risk Analysis in any area of the human society. Such a need is embedded in human evolution and it gains importance every time one needs to develop forecasts of future courses of action.

The current paper entitled "Part One - Why Risk Analysis?" represents the beginning of a series that is going to be published in the subsequent issues of the Journal of Defense Resources Management (referred to as Journal from here on). The series will contain topics to enhance understanding and knowledge of Risk and Risk Actions (Analysis, Assessment, Management, etc). Even though covering this multi-sided field is not a pragmatic goal, the authors to embark on this project series will attempt to approach it from as many standpoints as possible

The Journal Risk Analysis Series aims at covering both general topics like What Is Risk Analysis, What Fields Does Risk Analysis Apply To, Risk Analysis Specifics for

Specific Fields, How Others Do Risk Analysis & Need for Improvement, Risk Analysis & Compared Risk Management, etc., and specific topics such as Defense Resources Management Risk Analysis accompanied by corresponding case studies, intended to represent references for those who wish to develop their skills in Risk Analysis.

Why Risk Analysis? Because:

- humans want to push away, as far as possible from their daily routine, the unknown and uncertainty.

- certainty counts for less than 1% in our lives. However, we still believe it is safe to go on with it.

- people like to play risky but they do not like to lose.

- companies face risk if they move forward, and they face risk if they stand still.

- almost everything we do in today's business world involves a risk of some kind: customer habits change, new competitors appear, and factors outside any control could delay projects. Therefore, risk analysis and risk management can help assess these risks and decide what actions to take to minimize

disruptions to plans. Moreover, they can also contribute to deciding whether the strategies to be used to control risk are cost-effective.

- coming down to the societal or organizational levels, the overall security of that entity is at stake when acting without being aware of possible threats or risks calculated, miscalculated or not yet calculated.

- it can be as simple or as complex as one wants it to be, according to several factors such as a person's level of understanding (that is why risk analysis is performed only from a certain level above by any organizational entity), level of expertise, intelligence, statistical tools available, etc.

- historically, it is embedded in human evolution and actions, whether that was a matter of purposeful action or just reflex. People have always had something they considered valuable (evaluated against a scale ranging from very important, normal or less important) and hence, they granted assessed their fears, concerns, frights or dreads not to lose the things they cared for against such scales of importance. The more intense the feeling, the higher the level of importance they granted to that thing, accordingly.

Thus, in time people started to keep and pass on this knowledge because it was half experienced and half thought of. The half thought was understandable for quite a few, in the beginning, but the experienced half could very easily be transmitted by different means. Historically one can see here oral and written communication using a plethora of means for both oral and written ways, according to the respective level of societal evolution during a certain age.

- one wishes to identify threats.

The first stage of risk analysis consists in the identification of threats looming ahead such as: human – posed by individuals or organizations, illness, death, etc.; operational – emerging from supplies and operations disruption, loss of access to essential assets, distribution failures, etc.; reputational emerging from loss of business partner's or employee's confidence, or damage to reputation in the market; procedural resulting from failures in accountability, from internal systems and controls, from organization, fraud, etc.; project – the risks of cost over-run, jobs taking too long to accomplish, insufficient product or service quality, etc.; financial stemming from business failure, stock market, interest rates, unemployment, etc.; technical – advances in technology, technical failure, etc.; natural – threats from weather, natural disaster, accident, disease, etc.; political – changes in tax regimes, public opinion, government policy, foreign influence, etc.

Threat analysis is important because it is so easy to overlook important threats. One way of trying to capture them all is to use a number of different approaches. Firstly, run through a list such as the one above, to see if any apply. Secondly, think through the systems, organizations or structures you operate, and analyze risks to any part of those. Next, see if you can see any vulnerability within these systems or structures. Ask other people, who might have different perspectives.

By following all these “Why Risk Analysis” questions, one actually takes the first step in this episodically developed trip. The result is risk perception.

When perceptions about something are not similar, serious

differences of opinion appear before even starting the very first activity which is to deal with Risk Analysis.

Risk perception is the subjective judgment that people make about the characteristics and severity of a risk. The phrase is most commonly used in reference to natural hazards and threats to the environment or health, such as nuclear power.

Several theories explain why different people make different estimates of the dangerousness of risks. Three major families of theory have been developed: psychological approaches (both heuristics and cognitive), anthropology/sociological approaches (the cultural theory) and interdisciplinary approaches (the social amplification of risk framework).

The study of risk perception originates from experts' and laymen' disagreements on defining various risk and natural hazards.

The mid 1960s saw the rapid rise of nuclear technologies and the promise for clean and safe energy. However, public perception shifted against this new technology. Fears of both dangers to the environment, as well as immediate disasters creating radioactive wastelands turned the public against this technology. According to the scientific and governmental communities, the problem was a difference between scientific facts and an exaggerated public perception of the dangers.

A key paper, written in 1969 by Chauncey Starr revealed the preference approach used to find out what risks are considered acceptable by society. The paper assumed that society had reached equilibrium in its judgment of risks, so the conclusions were that whatever risk levels actually existed in society,

they were acceptable. The major finding of the paper was that people will accept risks 1,000 times greater if they are voluntary (*e.g.* driving a car) than if they are involuntary (*e.g.* a nuclear disaster). This approach assumed that individuals behave in a rational manner, and they weigh information before making a decision. People fear due to inadequate or incorrect information. Hence, additional information can help people understand true risk and lessen their perception of danger. Another question was whether additional information could also deepen people's misunderstanding about something. While researchers in the engineering school did pioneer research in risk perception, by adapting theories from economics, the latter has little use in a practical setting. Numerous studies have rejected the belief that additional information, alone will shift perceptions.

The psychological approach focused on how people process information. Early works maintain that people use cognitive heuristics in sorting and simplifying information which leads to biases in comprehension. Later work built on this foundation became the so called psychometric paradigm. This type of approach identifies numerous factors responsible for influencing individual perceptions of risk, including dread, newness, stigma, and other factors.

The earliest psychometric research was conducted by the psychologists Daniel Kahneman and Amos Tversky, who performed a series of gambling experiments to see how people evaluated probabilities. Their major finding was that people use a number of heuristics to evaluate information. These heuristics are usually useful shortcuts for thinking, but they may

lead to inaccurate judgments in some situations – in which case they become cognitive biases.

Representativeness is usually employed when people are asked to judge the probability that an object or event belongs to a class/processes by its similarity. The results may be insensitivity to prior probability, to sample size, misconception of chance, insensitivity to predictability, illusion of validity, misconception of regression.

Availability refers to events that can be more easily brought to mind or imagined and hence are judged to be more likely than events that could not easily be imagined. The biases result due to ability to retrieve instances, due to the effectiveness of research set, due to the ability of imagination and illusory correlation.

Anchoring and Adjustment occur when people often start with one piece of known information and then adjust it to create an estimate of an unknown risk – but the adjustment will usually not be big enough. The results are insufficient adjustment, biases in the evaluation of conjunctive and disjunctive event (conjunction fallacy), anchoring in the assessment of subjective probability distributions.

Asymmetry between gains and losses: people are risk averse with respect to gains, preferring a sure thing over a gamble with a higher expected utility but which presents the possibility of getting nothing. On the other hand, people will be risk-seeking about losses, preferring to hope for the chance of losing nothing rather than taking a sure, but smaller, loss (*e.g.* insurance).

Threshold effects: people prefer to move from uncertainty to certainty over making a similar gain in certainty

that does not lead to full certainty. For example, most people would choose a vaccine that reduces the incidence of disease A from 10% to 0% over one that reduces the incidence of disease B from 20% to 10%.

Another key finding was that experts are not necessarily any better at estimating probabilities than non-expert people. Experts were often overconfident in the exactness of their estimates, and put too much stock in small samples of data.

The majority of people in the general public express a greater concern for problems which appear to possess an immediate effect on everyday life such as hazardous waste or pesticide-use than for long-term problems that may affect future generations such as climate change or population growth. People greatly rely on the scientific community to assess the threat of environmental problems because they usually do not directly experience the effects of phenomena such as climate change. The exposure most people have to climate change has been impersonal; most people only have virtual experience through documentaries and news media in what may seem like a “remote” area of the world. This is why, coupled with the population’s wait-and-see attitude, people do not understand the importance of changing environmentally destructive behaviors even when experts provide detailed and clear risks caused by climate change.

Research within the psychometric paradigm turned to focus on the roles of affect, emotion, and stigma in influencing risk perception. Melissa Finucane and Paul Slovic have been among the key researchers. These researchers challenged Starr’s article by examining expressed preference –

how much risk people say they are willing to accept. They found that, contrary to Starr's basic assumption, people generally saw most risks in society as being unacceptably high. They also found that the gap between voluntary and involuntary risks was not nearly as great as Starr claimed.

Slovic and team found that perceived risk is quantifiable and predictable. People tend to view current risk levels as unacceptably high for most activities, as long as it is not their own decision to make. All things being equal, the greater people perceived a benefit, the greater the tolerance for a risk. If a person derived pleasure from using a product, people tended to judge its benefits as high and its risks as low as the level of pleasure they achieved. If the activity was disliked, the judgments were opposite accordingly. Research in psychometrics has proven that risk perception is highly dependent on intuition, experiential thinking, and emotions.

Psychometric research identified a broad domain of characteristics that may be condensed into three high order factors: 1) the degree to which a risk is understood, 2) the degree to which it evokes a feeling of dread, and 3) the number of people exposed to the respective risk. A dread risk elicits visceral feelings of terror, uncontrollable, catastrophe, inequality, and uncontrolled self. An unknown risk is new and unknown to science. This is why it is called risk, in the first place. The more a person dreads an activity, the higher it's perceived risk and the more that person wants the risk reduced.

As a short review of the second category of theories, the anthropology/ sociology approach posits risk perceptions as produced

by and supporting social institutions. In this view, perceptions are socially constructed by institutions, cultural values, and ways of life. Here, the Cultural Theory is based on the work of anthropologist Mary Douglas and political scientist Aaron Wildavsky, and was first published in 1982.

In Cultural Theory, Douglas and Wildavsky outline four "ways of life" in a grid/group arrangement. Each way of life corresponds to a specific social structure and a particular outlook on risk. Grid categorizes the degree to which people are constrained and circumscribed in their social role. The tighter binding of social constraints limits individual negotiation capabilities. Group refers to the extent to which individuals are bounded by feelings of belonging or solidarity. The greater the bonds, the less individual choice are subject to personal control. Four ways of life include: Hierarchical, Individualist, Egalitarian, and Fatalist.

Risk perception researchers have not widely accepted Cultural theory. Even Douglas says that the theory is controversial and poses the danger of moving out of the favored paradigm of individual rational choice of which many researchers are comfortable.

The third branch group of theories deals with the Interdisciplinary approach, main surfacing concept here being Social amplification of risk framework.

The Social Amplification of Risk Framework (SARF), combines research in psychology, sociology, anthropology, and communications theory. SARF outlines how communications of risk events pass from the sender through intermediate stations to a receiver and in the process serve to amplify or attenuate perceptions of risk. All links in the

communication chain, individuals, groups, media, etc., contain filters through which information is sorted and understood.

The SAR framework attempts to explain the process by which risks are amplified, receiving more public attention, or attenuated, receiving less public attention. The framework may be used to compare responses from different groups in a single event, or analyze the same risk issue in multiple events. In a single risk event, some groups may amplify their perception of risks while other groups may attenuate, or decrease, their perceptions of risk. The main thesis of SARF states that risk events interact with individual psychological, social and other cultural factors in ways that either increase or decrease public perceptions of risk. Behaviors of individuals and groups then generate secondary social or economic impacts

while also increasing or decreasing the physical risk itself.

These ripple effects caused by the amplification of risk include enduring mental perceptions, impacts on business sales, and change in residential property values, changes in training and education, or social disorder. These secondary changes are perceived and reacted to by individuals and groups resulting in third-order impacts. As each higher-order impacts are reacted to, they may ripple to other parties and locations. Traditional risk analyses neglect these ripple effect impacts and thus greatly underestimate the adverse effects from certain risk events. Public distortion of risk signals provides a corrective mechanism by which society assesses a fuller determination of the risk and its impacts to such things not traditionally factored into a risk analysis.

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