Lecture three

Chapter 1 Social Risk Management

The risk problems facing society today have many characteristics that limit and otherwise complicate the application of formal analysis. Since not all problems possess these complicating qualities to the same degree, some problems may be addressed more effectively by certain decision-aiding approaches than by others. To identify the most useful approach, the analyst must clearly understand the decision problem being addressed. A comparative evaluation of approaches must therefore begin with a characterization of social risk management decisions. The purpose of this chapter is to describe the nature of social risk management and to identify some of the important dimensions along which risk decisions differ. Discussed first is the nature of the risks that create public concern and pressures for government action. This is followed by a discussion of possible government roles in risk management and an exploration of the factors that make government risk decisions difficult. Next, the institutions and mechanisms that have evolved for social risk management are summarized, and finally, a preliminary taxonomy is provided for distinguishing among risk problems. (Merkhofer, 1986)

Nature of Risk

What is risk? What causes risk? How much risk are we currently facing? These questions are more difficult to answer than one might expect. To begin with, risk is not an easy word to define. People speak of business risk, social risk, economic risk, safety risk, investment risk, military risk, political risk, and so on. Depending on context, risk can mean different things. A dictionary lists several definitions, including «the possibility of suffering harm," "the amount an insurance company stands to lose," and "the possibility and degree of loss or injury." Our perspective in defining risk is consistent with the broadest and most general of the definitions presented by risk analysts: risk is defined as an uncertain situation in which a number of possible outcomes might occur, one or more of which is undesirable. With this definition, uncertainty is clearly fundamental to the concept of risk. If you know for certain that you will bear the burden of some specific undesired outcome, we might feel sorry for you, but we would not say that you are experiencing risk. If the focus is decision making, estimating the magnitude of risk so as to permit a comparison of the risks associated with alternative actions is the major concern. In the case of a risk associated with an event, experiments show that people's perceptions of the magnitude of the risk depend on how likely they think the event is and how serious they consider the effect to be. Following this line of reasoning, risk analysts argue that the level of risk should be measured in terms of the probability (relative likelihood) of the possible outcomes (in a given time period) and measures of the magnitude (seriousness) of the consequences of those outcomes. Fundamentally, then, risk may be represented as a probability distribution over consequences.(Merkhofer, 1986)

Figure 1 illustrates several of the most common ways to display a risk that has been quantified as a probability distribution. Figure l (a) applies to a case in which there are only two possible outcomes to a risk, for example, death or no death. In this case the probability of the bad outcome, probability of death, is sufficient to describe the probability distribution. Figure 1(b) shows a probability display applicable to the case where the risk involves a range of possible consequence levels. The curve is called a cumulative probability distribution and its height at any consequence level shows the probability that actual consequences will be less than or equal to that level. Figure I (c) is the reverse of the cumulative probability distribution. Its height at any consequence level indicates the probability that actual consequences will be greater than or equal to that level, and it is called a complementary cumulative probability distribution. It is also sometimes called a <u>risk profile</u>. Figure 1(d) is an intuitive but less easy to use display called a probability density function. The height of the curve at any given consequence level is proportional to the relative likelihood of that level of consequence occurring. The probability of consequence levels between any two values may be obtained as the area under the curve between those values. Figure 1(e) illustrates the sort of display that may be needed to describe risks that produce more than one type of consequence, for example, multiple deaths and property damage. The figure shows a joint probability density function. The curve defines a surface whose height at any point is proportional to the relative likelihood of simultaneously obtaining the combination of consequences associated with that point.(Merkhofer, 1986)

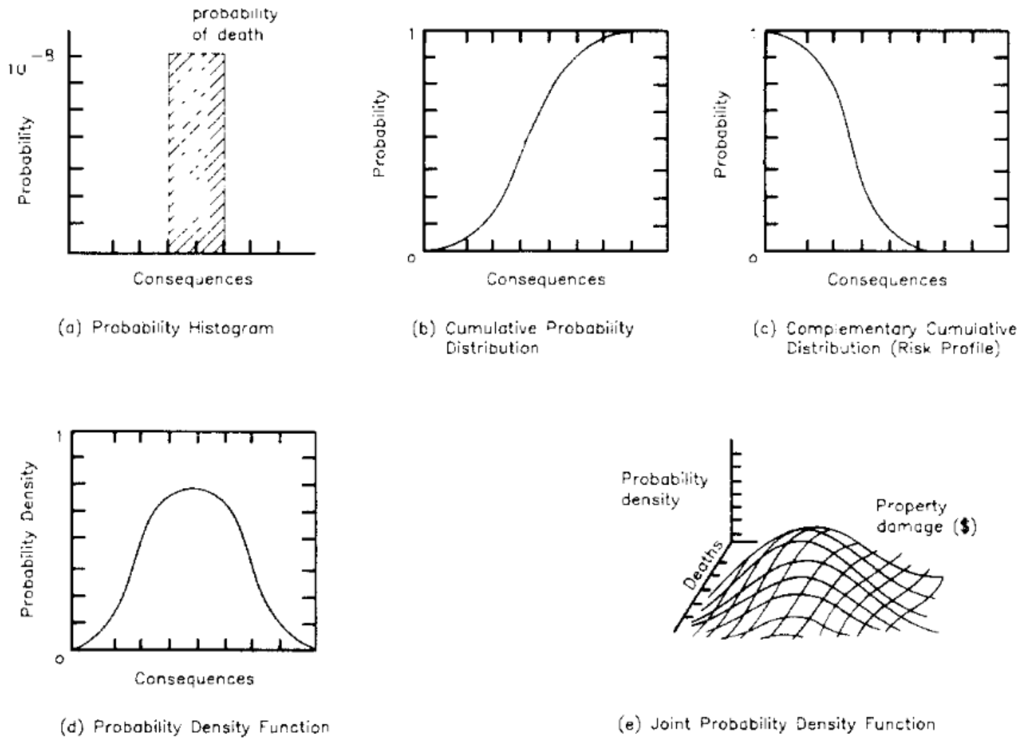

Fig. 1. Common ways to display quantified risks.

Fig.1. from: (Merkhofer, 1986)

The consequences represented in probability distributions that quantify risks might be adverse effects to human health, plants, animals, materials, or other items of value, and might be measured in terms of fatalities, injuries, days of disability, man-hours of labour lost, incidence of cancer, property lost, or fish killed. Just how probability distributions for these sorts of consequences might be computed or estimated as part of a decision-aiding approach is described in the upcoming lectures. The purpose of introducing such technical issues at this point is to clarify the concept of risk that is adopted throughout the discussion. Notice that conceptualizing risk as a probability distribution allows risks to be altered either by a change in probabilities or by a change in possible consequences. This two-dimensional characteristic makes it im- possible to find a completely satisfactory single number for measuring the level of risk. Common single-number summary statistics, such as the probability of loss, the maximum credible consequence level, the expected number of fatalities per year, the probability of fatality per exposed person per year, and so forth, fail to distinguish adequately among the different forms that risk can take. For example, the most commonly used summary measure is expected value of risk - the sum (= or integral=total) of the products of probabilities and consequences. This measure fails to distinguish risks that involve a large probability of minor consequences from those that imply a small probability of a major catastrophe.(Merkhofer, 1986)