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Toward a concept of risk for effective military decision making

David R. Mandel

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Abstract

This report critically examines existing concepts of risk and offers recommendations for improving the definition of risk and other risk-related terms. The author highlights the fact that the concept of risk is problematic because it is ambiguous and vague. In the vernacular, risk has multiple meanings including (a) risk as potential loss, (b) risk as a probability of a negative event occurring, and (c) risk as variability, volatility, or uncertainty regarding events in the future. In addition, many organisational definitions of risk define the concept in terms of an integration of the probability of a threat and the severity of its potential consequences. The author examines the definition of risk promulgated by (a) the Government of Canada through the Treasury Board Secretariat in its 2001 Integrated Risk Management Framework, (b) the Department of National Defence and Canadian Forces (DND/CF) through the 2002 Joint Doctrine on Risk Management for CF Operations and the 2005 Integrated Risk Management Guideline and Policy documents, and (c) the Canadian Standards Association (CSA) and the International Organization for Standardization and International Electrotechnical Commission (ISO/IEC). The report concludes with recommendations for the definition of risk, expected utility, and uncertainty, which the author proposes form a set of concepts that can contribute to effective decision making in defence and security contexts.

Résumé

Ce rapport examine d'un œil critique les concepts du risque actuels et présente des recommandations afin d'améliorer la définition du risque et d'autres termes liés aux risques. L'auteur souligne le fait que le concept du risque est problématique parce qu'il est ambigu et vague. Dans le langage quotidien, le risque a de multiples significations : (a) le risque comme la perte possible; (b) le risque comme la probabilité d'un résultat négatif; (c) le risque comme la variabilité, la volatilité ou l'incertitude à l'égard de cas futurs. De plus, de nombreuses définitions organisationnelles du risque définissent le concept selon l'intégration de la probabilité d'une menace et de la gravité de ses répercussions possibles. L'auteur examine la définition du risque publiée par (a) le gouvernement du Canada dans le Cadre de gestion intégrée du risque de 2001 par le Secrétariat du Conseil du Trésor du Canada, (b) de la doctrine interarmées sur la gestion du risque pour les opérations des FC de 2002 et les documents de politique et les directives de l'intégration de la gestion du risque de 2005 du ministère de la Défense nationale et des Forces canadiennes et (c) de l'Association canadienne de normalisation (CSA) et l'Organisation internationale de normalisation (ISO) et la Commission électrotechnique internationale (CEI). La conclusion du rapport présente des recommandations pour la définition du risque, la fonction d'utilité, et l'incertitude, pour lesquelles l'auteur propose un ensemble de concepts qui favorisent un processus efficace de prise de décision dans des contextes de défense et de sécurité.

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Executive summary

Toward a concept of risk for effective military decision making

David R. Mandel; DRDC Toronto TR 2007-124; Defence R&D Canada – Toronto; December 2007.

This report critically examines existing concepts of risk and offers recommendations for improving the definition of risk and other risk-related terms. The author highlights the fact that the concept of risk is problematic because it is ambiguous and vague. In the vernacular, risk has multiple meanings including (a) risk as potential loss, (b) risk as a probability of a negative event occurring, and (c) risk as variability, volatility, or uncertainty regarding events in the future. In addition, many organisational concepts of risk define it in terms of an integration of the probability of a threat and the severity of the potential consequences of that threat.

The author specifically examines the definition of risk promulgated by (a) the Government of Canada through the Treasury Board Secretariat in its 2001 Integrated Risk Management Framework, (b) the Department of National Defence and Canadian Forces (DND/CF) through the 2002 Joint Doctrine on Risk Management for CF Operations and the 2005 Integrated Risk Management Guideline and Policy documents, and (c) the Canadian Standards Association (CSA) and the International Organization for Standardization and International Electrotechnical Commission (ISO/IEC). The definition of risk provided by the Integrated Risk Management Framework, which the Department of National Defence adopted in its 2005 Integrated Risk Management Guideline and Policy documents, is judged to be problematic because it conflates two distinct connotations of risk—risk as uncertainty about future events and risk as the integration of threat probability and consequence severity. The author proposes that the definition of risk provided by the joint doctrine on risk management in CF operations is less ambiguous, but still vague, as are the definitions provided by both the CSA and the ISO/IEC standards.

The report concludes with recommendations for the definition of risk, expected utility, and uncertainty, which the author proposes form a set of concepts that can contribute to effective decision making in defence and security contexts. Risk is defined as "the expected loss associated with an event. It is measured by combining the magnitudes and probabilities of all of the possible negative consequences of the event." Expected utility refers to the expected value of an event. It is measured by combining the signed magnitudes and probabilities of all of the possible consequences of the event. Thus, in contrast to risk, expected utility takes into account both positive and negative expected outcomes. Uncertainty refers to the degree of variability in the possible values associated with an event. It is proposed that these three definitions (risk, expected utility, and uncertainty) cover most of the interpretations in which risk has been used in government and defence policies and military doctrine, while using distinct, but accessible, terminology.

Sommaire

Toward a concept of risk for effective military decision making

David R. Mandel; DRDC Toronto TR 2007-124; R & D pour la défense Canada – Toronto; Décembre 2007.

Ce rapport examine d'un œil critique les concepts du risque actuels et présente des recommandations afin d'améliorer la définition du risque et d'autres termes liés aux risques. L'auteur souligne le fait que le concept du risque est problématique parce qu'il est ambigu et vague. Dans le langage quotidien, le risque a de multiples significations : (a) le risque comme la perte possible; (b) le risque comme la probabilité d'un résultat négatif; (c) le risque comme la variabilité, la volatilité ou l'incertitude à l'égard de cas futurs. De plus, de nombreuses définitions organisationnelles du risque définissent le concept selon l'intégration de la probabilité d'une menace et de la gravité de ses répercussions possibles.

L'auteur examine particulièrement la définition du risque publiée par (a) le gouvernement du Canada dans le Cadre de gestion intégrée du risque de 2001 par le Secrétariat du Conseil du Trésor du Canada, (b) de la doctrine interarmées sur la gestion du risque pour les opérations des FC de 2002 et les documents de politique et les directives de l'intégration de la gestion du risque de 2005 du ministère de la Défense nationale et des Forces canadiennes et (c) de l'Association canadienne de normalisation (CSA) et l'Organisation internationale de normalisation (ISO) et la Commission électrotechnique internationale (CEI). La définition du risque fournie dans le Cadre de gestion intégrée du risque, que le ministère de la Défense nationale a ajouté aux documents de politique et aux directives de gestion intégrée du risque de 2005, est jugée problématique parce qu'elle réunie deux connotations distinctes du risque : le risque comme incertitude par rapport aux cas futurs et le risque comme l'intégration de la possibilité d'une menace et de la gravité des répercussions. L'auteur suggère que la définition du risque fournie dans la doctrine interarmées sur la gestion du risque pour les opérations des FC est moins ambigüe, mais encore vague, comme le sont les définitions fournies dans les normes de la CSA et de l'ISO/CEI.

La conclusion du rapport présente des recommandations pour la définition du risque, la fonction d'utilité, et l'incertitude, pour lesquelles l'auteur propose un ensemble de concepts qui favorisent un processus efficace de prise de décision dans des contextes de défense et de sécurité. Le risque est défini comme « la perte prévue associée à un cas. Il est évalué en combinant l'importance et les probabilités de toutes les répercussions négatives possibles d'un cas ». La fonction d'utilité désigne la valeur prévue d'un cas. Elle est évaluée en combinant l'importance et les possibilités approuvées de toutes les répercussions possibles d'un cas. Alors, par rapport au risque, la fonction d'utilité tient compte des résultats positifs et négatifs prévus. L'incertitude désigne le degré de variabilité des valeurs possibles associées à un cas. On propose que ces trois définitions (risque, fonction d'utilité et incertitude) tiennent compte de la majorité des interprétations dans lesquelles le risque a été utilisé dans le contexte du gouvernement et de la doctrine militaire et des politiques de défense, tout en utilisant une terminologie distincte et accessible.

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Introduction

Nowadays, few would challenge the notion that effectively managing risk is a fundamental requirement for making sound decisions. The Government of Canada (GoC) reflects this view through its promulgation of integrated risk management (IRM) as a core concept designed to improve the effectiveness of organizational decision making. In 1998, The Privy Council Office convened a working group of Assistant Deputy Ministers to consider risk management issues in the public policy domain. In 2000, this group published a report recommending the development of a government risk management framework [1]. A document expressing a commitment to developing an IRM framework was also tabled in Parliament [2]. Affirming this commitment, the Treasury Board of Canada Secretariat published the Integrated Risk Management Framework (IRMF) in 2001, which it describes as a practical guide designed to assist public service employees in their decision making [3].

The IRMF is a government-wide policy, applicable to both the Department of National Defence and the Canadian Forces (DND/CF). In response to the GoC's objective of promulgating the IRMF throughout government, the DND/CF began developing a framework for Integrated Strategic Risk Management in Defence (ISRM). In April 2001, the VCDS, Vice-Admiral Garnett, introduced the concept of ISRM:

> It represents the Department's first steps in defining corporate strategic risk and how it is managed. It is intended to compliment the Treasury Board's initiative in producing the Integrated Risk Management Framework and to suggest risk management actions and methods that will support Defence objectives [4].

However, a 2004 Chief Review Services IRM audit of the DND/CF concluded that "no commonly accepted risk process is evident in the DND/CF" [5]. Moreover, the audit report stated that "outside of areas where risk management is traditionally used in the DND/CF, little understanding or articulation of the concept of IRM – and how it needs to be integrated as part of normal, day-to-day planning, decision-making and performance management – is evident" [6]. In October 2005, the DND/CF produced an IRM policy statement [7] and IRM guidelines [8] that, together, are geared toward harmonizing risk management policy and practice with the IRMF. According to the policy statement, "DND and the CF will adopt Integrated Risk Management as defined by Treasury Board and used within the GoC. Furthermore, the risk management methodology will be incorporated into our business planning and performance management processes; a separate integrated risk management framework will not be created" [9].

Given that the DND/CF has explicitly expressed its commitment to adhere to the IRMF and, moreover, given that the GoC will continue to evaluate it in terms of its compliance with the IRMF, it is important to examine the concept of risk both as defined by the IRMF and the DND/CF. In the present article, I examine the risk concept in some detail as it is more generally defined and also as it is specifically defined within the IRMF, DND/CF IRM policy and guidelines, and DND/CF doctrine. This examination reveals some of the troubling vagaries and ambiguities inherent in the concept of risk. The article concludes by offering some recommendations for standardizing the usage of risk and risk-related concepts along sound connotative lines; namely, lines intended to support effective organizational decision making both within military contexts and within the wider governmental sphere.

The Integrated Risk Management Framework

To begin with, consider the IRMF definition of IRM itself, and how it is meant to differ from "plain old" risk management. According to the IRMF,

> Integrated risk management is a continuous, proactive and systematic process to understand, manage and communicate risk from an organization-wide perspective. It is about making strategic decisions that contribute to the achievement of an organization's overall corporate objectives" [10].

The IRMF distinguishes IRM from risk management, which it defines as "a systematic approach to setting the best course of action under uncertainty by identifying, assessing, understanding, acting on and communicating risk issues" [11]. The distinction reflects the view of GoC policy makers that even effective risk management does not go far enough to ensure organization-wide success in a world in which organizations must often respond simultaneously and rapidly to a diverse array of challenges. Rather, according to this viewpoint, strategic effectiveness requires management to proactively promulgate a "risk management culture [that] supports the overall vision, mission and objectives of an organization" [12]. In this culture, decision makers across all levels of an organization are explicitly encouraged to develop a common understanding of the challenges and opportunities they face in terms of risk, and to communicate risk-relevant information horizontally as well as vertically within the organization. IRM is thus intended to go beyond the development of stove-pipe procedures for handling risk and is aimed at cultivating an organizational culture in which its members are deeply attuned to the concept of risk and in which they routinely and actively perceive, assess, respond to, and communicate information about risks within their operational environments.

Regardless of what the real or anticipated differences between risk management and IRM may be, both share a fundamental commonalty; namely, that for either type of policy or practice to support effective decision making it must begin with a cogent understanding of what the term *risk* means. At first glance, the task of conceptualizing risk may appear trivial. After all, given that most people seem to have a fairly good idea of what they mean by risk, surely "the experts" tasked with one or more of the various aspects of risk management must know what they mean by risk. Moreover, these experts must largely agree on a standard definition of risk. Unfortunately, these "reasonable assumptions" need not be true. And, in fact, as we shall see, the concept of risk is mired in vagueness and ambiguity, which threatens to undermine its utility to decision makers.

What's wrong with *risk*?

The key problem with the term *risk*, as many scholars have noted, is that it has too many connotations, some of which are fairly vague [13, 14]. When risk is defined more precisely, it becomes evident that there are already other terms that mean the same thing. Therefore, decision makers are left with a term that is either imprecise or superfluous. Indeed, as one economist boldly put it,

> "Risk"—interpreted to subsume all cognate terms and expressions such as risk assessment, risk perception, risk factors, acceptable risk, etc.—should be abandoned by everyone interested in improving public or personal decisions. Its multiple, confusing and ambiguous usages persistently interfere with the distinct tasks of identifying and evaluating knowledge and evidence relevant to the decision on the one hand and eliciting and processing value judgments relevant to it on the other, as well as making it much more difficult for the necessary integration of these two distinct types of inputs to be achieved in a coherent and transparent way" [15].

If this assessment is correct, it would be reasonable to ask why government policy makers should bother to define the concept of risk at all. Indeed, the preceding assessment suggests that they would be better off advocating an all-out ban on the use of this four-letter word rather than promoting a risk management culture. Although the charge of ambiguity against the term *risk* is in fact correct, banning the use of this term is not a realistic option at this time. Several government policies are currently formulated in the language of risk. That cannot be changed overnight and probably will not undergo fundamental change for years, if not decades, to come. Indeed, at present, we are witnessing an increase in the use of the risk concept, as the IRMF exemplifies.

More significantly, and perhaps reflective of why we are in the current state, is that fact that the concept of risk has tremendous psychological appeal. Part of that appeal likely stems from the fact that risk is strongly associated with attention-grabbing threats and losses. Bad news usually headlines because it captures attention and generates interest. The same is true for *potential* bad news—namely, risks. Another part of the appeal of the risk concept is that most people have an intuitive notion of what risk is, however imprecise that notion may be. Thus, experts can talk about risks to non-experts in ways that they could not do if they were instead talking about a more clearly-defined, but less well-known or "user-friendly," concept such as expected utility (a concept to which I shall return later).

Indeed, the many-to-many mapping of meanings in the context of risk communication may be appealing for precisely the same reason that it can be ineffective: Risk communicators can feel at least somewhat assured that their audiences are understanding their message (though not necessarily as intended) and interpreters of risk communications can feel at least somewhat confident that they know what the communication means (even when they are wrong). The comfort of this sort of illusory understanding is, however, a luxury that comes at a real cost: In the long run, miscommunication regarding outcomes, probabilities, and uncertainties will undermine effective decision making and may also weaken trust between the communicating stakeholders. Where this proves to be unacceptable, clarity may be sought through creation of risk assessment procedures. Sometimes this helps, but "standard procedures" still do not imply

standard interpretations of those procedures, their inputs, or their outcomes. In the end, there is no substitute for conceptual clarity. Such clarity should in fact provide the foundation upon which assessment processes are built.

Common connotations of risk

Risk is commonly used to connote at least four distinct meanings. In the first connotation, risk is synonymous with probability. Let us call this the R=P definition. For instance, a cigarette smoker named Bob might assess his risk of dying from smoking as very low, by which he means that the probability, likelihood, or chance of that outcome happening is very low. This definition illustrates the case in which risk is superfluous, for if one merely intended to refer to the probability of an event, *X*, then it would be clearer to say that the probability of *X* is, for instance, "very high" than to say that the risk of *X* is "very high." Of course, the term *probability* has multiple meanings too, referring, for instance, to uncertainty that is on the one hand subjective and on the other hand objective [16]. Even so, these interpretations tend to be more precise and circumscribed than interpretations of risk.

The allure of using risk in place of probability appears to owe much to the tendency for people to be *loss averse*. Loss aversion refers to the fact that the negative utility or displeasure that an individual experiences as a consequence of incurring a loss tends to outweigh the positive utility or pleasure that the same individual would experience as a consequence of securing a gain of the same objective magnitude [17]. In other words, losses tend to loom larger than gains of corresponding magnitude. Loss aversion promotes a loss focus (and, again, this is partly, and perhaps largely, why bad news is attention-grabbing). Almost invariably, when the term *risk* is used in the R=P sense, it is intended to highlight that a focal event is associated with possible, and usually significant, loss. Indeed, it would be odd to talk about the risk of positive events unless there was also some chance of an unwanted negative outcome occurring. For instance, although it would sound quite natural to refer to the risk of *gambling on the lottery*, which may conjure up thoughts of losing money or even of becoming addicted to gambling, it would sound odd to refer to the risk of *winning the lottery*, with its predominantly positive image. This negative bias, or focus on "failure probabilities" [18] is evident even in international standards. For instance, the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) 2002 guide on risk management vocabulary notes that "the term 'risk' is generally used only when there is at least the possibility of negative consequences" [19].

In the second connotation, which we may call the R=L definition, risk is synonymous with possible loss. For instance, referring to the earlier example, Bob's wife might counter Bob's assertion by saying that a premature death is a risk that her husband nevertheless faces if he continues to smoke. Here, the emphasis is on the *possibility* of loss occurring rather than on the probability of loss. Indeed, the use of the term risk in the R=L sense need not imply that the probability of the possible loss is high, but rather that the possibility is perceived as plausible. Such expressions are especially likely when the possible loss is of great concern (e.g., losing one's or a loved one's life). Once again, one could simply say that death is a possible consequence of smoking, which, as a statement, is clearer and also appears to be less emotionally stirring than saying that death is a risk of smoking.

The third connotation of risk, which, as we shall see later, is commonly reflected in risk assessment methods, conveys a combination of the probability (P) and magnitude (M) of loss associated with the occurrence of a particular event or type of event. Let us call this the R=PM definition of risk. For example, Bob's friend might buttress the wife's claim by adding that the scientific evidence unequivocally indicates that smoking risk is very high. Clearly, the friend does

not mean that the probability of smoking *per se* is very high. Rather, the implied meaning is that the combination of the magnitudes or impacts of the possible losses associated with smoking on the one hand and the probabilities of the possible losses on the other hand represents a very high level or degree, although the nature of how probability and magnitude is scaled and how these measures are combined remains implicit in the risk statement and, therefore, it remains vague as well.

There are at least two variants of this third connotation of risk that deserve further comment. The first extends the concept to both the positive and the negative outcomes or consequences of an event, replacing the univalent concept of loss with the bivalent concept of utility. In this broader sense, risk is akin to an event's *expected utility* (EU), a summation of the possible outcomes of the event weighted by their respective probabilities of occurrence. Accordingly, let us call this variant the R=EU definition of risk.

The second variant applies the concept of probability to the event, but applies the concept of magnitude to the expected consequence of the event. For instance, according to the ISO/IEC guide risk is defined as "[the] combination of the probability of an event and its consequences" [20]. This standard definition still requires a fair degree of unpacking. First, probabilities and consequences *per se* cannot be combined; rather, it is their estimates that may be combined by risk assessors. Second, the unpacked expression "estimate of the consequences" is still vague: does this refer to a probability estimate or a magnitude estimate? Given that most risk assessment procedures attempt to combine the probabilities and magnitudes of an event's possible negative consequences, let us assume it refers to the latter; namely, an estimate of the magnitude of the consequences. According to the ISO/IEC standard, then, risk refers to the combination of the probability estimate of *an event* and the signed estimate of the magnitude of *the event's consequences*. Let us refer to this definition as $R=PM^*$ to highlight that the two estimates apply to branches at different levels of a fault tree [21]. The $R=PM^*$ definition reflects another type of conceptual opaqueness; namely, one having to do with a failure to clearly specify the event to which an estimate is meant to apply [22]. This definition glosses over the fact that an event may result in multiple possible outcomes, each of which has a particular likelihood of occurring. The magnitude estimates of these possible outcomes should be combined with their respective probability estimates before integrating the derivative estimate with the prior probability of the generating event, but the $R=PM^*$ connotation of risk does not support this fundamental decision-analytic process.

In the fourth connotation of risk, which we may call the R=V definition, risk refers to the degree of variability among the possible outcomes associated with an event. For example, financial advisors usually ask their clients how much risk or uncertainty they are willing to tolerate before recommending an investment portfolio. By risk, these advisors are referring to the degree of volatility in the value of an investment instrument in the past that their clients are willing to accept. Moreover, because the direction and magnitude of fluctuations in an instrument's value are largely unpredictable, the degree of volatility tends to be proportional to the degree of uncertainty that investors will face in knowing what the future value of their investment in that instrument will be. The question of risk tolerance posed by financial advisors to clients is ultimately about their willingness to accept such uncertainty.

Note also that volatility represents variability in possible outcomes that may be entirely negative (i.e., losses), entirely positive (i.e., gains), or a mixture of losses and gains. Often, however, the

term risk will be employed only if there is a perception that the occurrence of negative outcomes is distinctly possible. Thus, although technically a gamble that offers an even chance of winning either $10 or $20 is risky in the R=V sense (i.e., there is variability in the possible outcomes), many people would not think of it as such because all of the possible outcomes constitute positive events. By contrast, it would be normal to think of a gamble offering an even chance of winning $10 or losing $8 as risky, even though the expected utility is positive, because there is the possibility of loss.

The multiple meanings of risk just discussed do not represent an exhaustive list. One could also point to the fact that risk may be used as a noun (e.g., “the risk to our mission is great”), as a verb (“the commander risked his troops’ lives”), as an adjective (e.g., “he chose a risky course of action”), or as an adverb (e.g., “the battalion advanced riskily toward the frontline”). However, the definitions I have highlighted are important in the present context because in each case risk is aligned with an important decision-analytic notion. Effective decision making requires that these notions should not be confused, but use of the term *risk* appears to increase the probability of precisely such confusion. That is, these multiple connotations of risk invite disagreement between individuals, organizations, and policy statements as well as within these entities. In the next section, I examine the definition of risk outlined in the IRMF and use it to illustrate the type of conceptual incoherence that can arise (and that has arisen) within and across statements about risk management.

The concept of risk in the IRMF

The IRMF defines risk in the following manner:

> Risk refers to the uncertainty that surrounds future events and outcomes. It is the expression of the likelihood and impact of an event with the potential to influence the achievement of an organization's objectives [23].

This definition provides a good example of the ambiguity and vagueness that can exist within a single (but important) policy document. The first sentence of the IRMF definition defines risk in R=V terms. The greater the risk, the greater will be the "uncertainty" or the variability in possible future outcomes. Nevertheless, the statement fails to clarify the nature of uncertainty that is to be regarded as relevant or most relevant. For instance, imagine that a possible consequence was bound to occur, but a decision maker was unaware of this fact and unsure of what might happen. In this case, the consequence may be regarded as entirely certain from an objective perspective but as highly uncertain from a subjective perspective. The IRMF definition offer little guidance on how different sources of uncertainty (e.g., subjective vs. objective) ought to be weighted or combined.

Whereas the first sentence illustrates the vagueness of the IRMF definition, the second sentence, when contrasted with the first, clearly illustrates that the definition is ambiguous as well, since it conveys an alternative R=PM concept of risk in which likelihood is synonymous with probability, and impact is used as a shorthand expression of the relevant outcome's magnitude. It remains unclear in this second definition whether only negative impacts are to be considered or whether positive impacts are also to be entered into the calculation of risk. This lack of clarity, in itself, may invite confusion given that the R=PM connotation of risk usually focuses on negative impacts only, whereas the valence-neutral language used in the IRMF would seem to also permit, if not encourage, a consideration of positive impacts—in other words, a bivalent R=EU concept of risk. If positive impacts were to be considered, however, it would be unclear what expressions like "greater risk" or "reduced risk" might mean. Indeed, it would make more sense under such circumstances simply to refer to the expected utility of an act, decision, or event rather than to its degree of risk.

To illustrate the confusion that could easily arise from the IRMF definition of risk, consider the following example involving a choice between two alternative courses of action (COA), which are designed to save 600 civilians who face imminent death in a war-torn region:[1]

> If COA 1 is taken, it is certain that 200 civilians would be saved and the remaining 400 civilians would die.
>
> If COA 2 is taken, there is a one-third chance that all 600 civilians would be saved and a two-thirds chance that all 600 civilians would die.

[1] For readers interested in people's choice selections in versions of this problem, see David R. Mandel, "Gain-loss framing and choice: Separating outcome formulations from descriptor formulations," Organizational Behavior and Human Decision Processes, 85(1), 56-76.

Putting aside the important question of which COA constitutes the best option, let us simply ask which one is the riskiest? If risk is defined in R=V terms, then COA 1 is less risky than COA 2 because there is no outcome variability in the former case (i.e., there is only one possible outcome, which is comprised of 200 lives saved and 400 lives lost) and the maximum possible outcome variability in the latter case (i.e., there are two possible outcomes, one representing the best possible outcome—namely, everyone saved—and the other representing the worst possible outcome—namely, everyone dies). From this definitional standpoint, COA 1 is "risk free" because there is only one possible outcome associated with it. Note, however, that this risk-free option (from an R=V standpoint) involves two-thirds of the civilians dying. Thus, in spite of its complete success in eliminating R=V risk, COA 1 might be seen as entailing an unacceptable loss. That is, it might be too risky from the R=L perspective.

If, however, risk is treated as an expression of the summation of the negative impacts of a given COA weighted by their probability of occurrence—namely, in R=PM terms—then both options would be equally "risky." This can be verified by multiplying the negative outcome for a given COA by its probability of occurrence:

For COA 1, R=PM = 1.0(–400) = –400.

For COA 2, R=PM = 0.67(–600) = –400.

Similarly, if risk were to be interpreted in R=EU terms, once again, the two options would be equally risky:

For COA 1, R=EU = 1.0(200) + 1.0(–400) = –200.

For COA 2, R=EU = 0.33(600) + 0.67(–600) = –200.

Thus, depending on how the IRMF is interpreted, a risk assessor could very reasonably conclude that COA 1 is much riskier than COA 2 (i.e., if risk means R=V) or that the two courses of action do not differ at all in terms of risk (i.e., if risk means R=PM or R=EU).

Note that, in the preceding example, both interpretations of the relative riskiness of the two options were legitimate given the manner in which the IRMF defines risk. Thus, the ambiguity that arose in that example did not stem from a mistaken translation of the IRMF's definition of risk; rather, it arose from the imprecision of the definition itself. There is ample evidence, however, that the IRMF definition of risk is also prone to mistaken translations. For example, one Canadian government report on risk management learning strategies defines risk by first quoting the IRMF definition of risk. In the following sentence of that report, however, the authors conclude that "risk in this sense is the probability that a future event – either good or bad – will occur" [24]. Thus, on the basis of the IRMF's ambiguous R=V / R=PM / R=EU definition of risk, the authors conclude that risk is to be interpreted in the R=P sense!

As well, consider the definition of risk provided in a 2003 Health Canada report entitled "Strategy to Implement an Integrated Risk Management Framework in Health Canada:"

> "Risk" refers to the uncertainty that surrounds future events and outcomes. It is the level of exposure to uncertainties that an organization must understand and effectively manage.

> Risk is the expression of the likelihood of a future event occurring as well as its potential to influence the achievement of an organization's objectives [25].

The first of these three sentences conveys the R=V connotation. The second sentence attempts to set the R=V definition in a relevant organizational context. The third sentence, however, diverges in interpretation by initially defining risk in R=P terms. Then, somewhat confusingly, the third sentence ends by alluding to the potential to influence the achievement of an organization's objectives in what seems to mean something akin to "risk is the probability of an event but only for events that matter to the organization." These examples illustrate the ease with which the risk concept can be applied inconsistently across policy statements, even in cases in which the aim is to conform to a single framework.

The concept of risk in the DND/CF

As noted earlier, the DND/CF has been taking steps over the past few years to harmonize its risk management policies and procedures with the IRMF. According to an early statement in 2001, ISRM "focuses on the management of strategic corporate risk. Operations risk management at the strategic, operational and tactical levels is accomplished through the operations planning process and is developed and perfected through operational research, lessons learned and doctrine development" [26]. This suggests that efforts to harmonize risk management practices with the IRMF would occur mostly on the DND corporate side and less on the CF operational side. However, the 2005 IRM policy statement does not make this distinction clear. And, in what appears to be a reversal of the earlier ruling, the 2005 IRM guidelines indicate that "they are intended to be generic and independent of any specific functional application (HR, construction, capital equipment projects) or organizational level (strategic, operational, or tactical) to ensure that they can be used throughout Defence" [27]. At present, then, the extent to which risk management in the context of the operations planning process is intended to adopt IRMF-consistent definitions and principles remains unclear.

It is clear, however, that multiple definitions of risk are still to be found within DND/CF risk-management documentation. Not surprisingly, the IRM policy statement and IRM guidelines both define risk in the same manner as the IRMF,[2] thus inheriting the conceptual ambiguities of that definition noted earlier. The IRM guidelines, however, indirectly suggest that the intent is to define risk in R=PM terms because the risk assessment procedures outlined in the guidelines involve prioritizing risk by combining likelihood (i.e., probability) and impact (i.e., magnitude), each of which is coded on 5-point scales as shown in Figure 1 [28].

These procedures share much in common with those outlined in the DND/CF doctrine. In 2002, the DND/CF published a Joint Doctrine Manual entitled "Risk Management for CF Operations" in which risks are to be prioritized using a matrix as shown in Figure 2 [29].

[2] See Annex A in both documents

Impact	Severe 5	Significant	High	High	Very High	Very High
	Major 4	Medium	Significant	High	High	High
	Moderate 3	Low	Medium	Significant	Significant	High
	Minor 2	Low	Low	Medium	Medium	Significant
	Insignificant 1	Low	Low	Low	Medium	Medium
		Rare 1	Unlikely 2	Possible 3	Likely 4	Almost Certain 5
		Likelihood				

Figure 1: Risk assessment matrix from the CF IRM guidelines

Risk Assessment Matrix						
		Probability				
Severity		Frequent A	Likely B	Occasional C	Seldom D	Unlikely E
Catastrophic	I	E	E	H	H	M
Critical	II	E	H	H	M	L
Marginal	III	H	M	M	L	L
Negligible	IV	M	L	L	L	L

Figure 2: Risk assessment matrix from the CF joint doctrine manual on risk management

In Figure 2, the letters L, M, H, and E refer to risks that are low, medium, high, and extremely high, respectively. Despite the differences in approach, both risk assessment matrices are consistent with the R=PM definition of risk. The doctrine manual, however, provides a definition of risk that is more congruent with what is in fact measured. It defines risk as "an expression of a possible loss or negative mission impact stated in terms of probability and severity of an event" [30] and then later defines it as "[the] chance of injury or loss expressed in terms of probability and severity" [31]. Probability, in turn, is defined as "the likelihood that an event will occur," and severity is defined as "the expected consequence of an event in terms of degree of injury, property damage, or other mission-impinging factors (loss of combat power, adverse publicity, etc.) that could occur" [32].

The DND/CF doctrine defines risk in relatively unambiguous terms. It clearly states that risk applies only to R=PM assessments of possible losses, not possible gains, thus ruling out (for better or worse) the R=EU interpretation. And, it goes on to provide clear definitions of probability and severity (i.e., M in the R=PM formulation). In short, from a definitional standpoint, the DND/CF doctrine on risk management is much clearer than the IRMF. The DND/CF doctrinal definition of risk also is in accordance with national and international standards. According to the Canadian Standards Association (CSA) 1997 guide on risk management for decision makers, risk is defined as "the chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value" [33]. And, as noted earlier, the ISO/IEC defines risk as "[the] combination of the probability of an event and its consequences" [34]. The definition of risk in the DND/CF doctrine is therefore congruent with both national and international standards, and is indeed more so than that offered by the IRMF. Nevertheless, as I also noted earlier, the ISO/IEC standard for defining risk lends itself to a faulty $R=PM^{*}$ interpretation, and consistency with this standard should not necessarily be viewed as beneficial for decision making.

Toward a concept of risk for effective decision making

Ultimately, organizations attempt to manage risk in the hopes of making satisfactory decisions at minimum and optimal ones at best. This usually means trying to capitalize on opportunities and maximize gains, while trying to avoid threats and minimize costs or losses, by selecting the alternative from a set of options that maximizes expected utility, subject to other possible constraints on choice selection, some of which may be voluntarily imposed (e.g., maxima for expected losses or outcome variability, minima for expected gains) and others of which may be outside of the decision maker's control (e.g., limited resources that may preclude reaching the best decision in principle). Techniques for improving decision making should, therefore, help the decision maker weight and combine the relevant information in a manner that lends itself toward achieving that goal, bearing in mind real constraints. Toward that end, policy makers should strive for conceptual clarity. The concepts underlying decision-analytic techniques should be clearly defined and unambiguous so that decision makers and other stakeholders will not only understand what they themselves mean when they use the concept; they will actually share the same meaning. We have seen that this is one of the fundamental problems with the concept of risk. It has too many meanings, many of which are vague.

In addition to being unambiguous and precise, concepts that support decision making should be general enough to be applicable across a wide range of organizational contexts and decision-making domains. The nature of the attributes that define the options under consideration may differ from one context to another, but the concepts used to resolve the problem of which alternative to select from an array of options should remain invariant. Furthermore, aspects of a concept that may limit one's ability to generalize the concept should be jettisoned from its core definition. This is especially important for policies that are meant to apply across a diverse set of organizations, such as the IRMF and national and international standards. For example, the CSA definition of risk noted earlier—namely, "the chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value"—could be improved in this regard simply by defining R=PM risk as follows:

> *Definition 1*: Risk refers to the expected loss associated with an event. It is measured by combining the magnitudes and probabilities of all of the possible negative consequences of the event.

There is no need to bog down the definition by referring to specific types of possible outcome, such as health, property, the environment, etc.

Whereas clarity, lack of ambiguity, and wide applicability may be necessary conditions for successfully defining concepts that support effective decision making, they are certainly not sufficient in this regard. A concept must also demonstrate *integrity* by lending itself to evaluation processes that support effective decision making. Take the aforementioned ISO/IEC definition of risk; it does a fair job of meeting the necessary criteria but nevertheless lacks integrity because it easily lends itself to a dubious $R=PM^*$ interpretation. Definition 1 avoids this dubious connotation and is appropriate if a decision maker wanted to assess the univalent R=PM concept of risk. In many instances, however, decision makers may be more interested in considering the bivalent R=EU concept of risk. To avoid confusion with the univalent notion, I recommend that the

bivalent concept be called *expected utility*, which is indeed what it represents, and defined as follows:

> *Definition 2*: Expected utility refers to the expected value of an event. It is measured by combining the signed magnitudes and probabilities of all of the possible consequences of the event.

Whereas Definition 1 retains a focus on the negative side of the balance sheet, and is consistent with the common usage of the term risk, Definition 2 emphasizes the integration of both positive and negative expected outcomes. Although a univalent focus on loss may be justified in some circumstances, such as when a decision to pursue a particular objective has already been made (e.g., an operational mission has been deemed necessary and now steps must be taken to minimize potential loss), as a general rule the bivalent notion provides a more complete basis for selecting among available options because the various options considered by a decision maker are likely to vary not only in terms of their possible drawbacks but also in terms of their possible strengths. By integrating both sides of the balance sheet, the option that maximizes expected utility should be more transparent, as should the reasons why. This fuller integration of decision-relevant information is advantageous not only in terms of optimizing choice, but also in terms of providing greater transparency and accountability for decision making. That is, it should be easier for policy makers to justify, and for citizens to understand, why a given choice was made by their government when that decision takes account of both the expected costs and benefits and does so in a consistent manner.

Despite the important difference between Definitions 1 and 2, both share in common the fact that they provide a measure of the central tendency of considered options. With Definition 1, the decision maker aims to minimize that value; with Definition 2, the aim is to maximize it. But, as the comparison of options in the rescue operation problem discussed earlier revealed, options may have similar or even identical central tendencies and, yet, different greatly in their variability. Without a measure of variability, decision makers will not have a clear sense of the range of possibilities that might transpire if a given option is adopted. Unfortunately, current operational definitions of risk make no attempt to gauge this type of variability, and national and international standards for defining risk seem to ignore the issue altogether. In order to keep the concept of risk from meaning too many things, I also recommend that the term *uncertainty* be used to convey the R=V connotation; this may be defined as follows:

> *Definition 3*: Uncertainty refers to the degree of variability in the possible values associated with an event.

Variability would normally be defined relative to an expected value. For example, it may be computed as the mean squared deviation of possible outcomes from the expected outcome. In the rescue operation problem described earlier, uncertainty computed in this manner would have a value of 0 for COA 1 since the only possible outcome is the expected outcome (namely, 200 are saved and 400 die). By contrast, uncertainty for COA 2 would have a value equal to $[(0 - 200)^2 + (600 - 200)^2] \div 2 = 1{,}000$. Thus, even though the risk (following Definition 1) and expected utility (following Definition 2) of the two options presented in this problem are identical, we see that the uncertainty associated with COA 2 is much greater and can be quantified.

Collectively, Definitions 1 (risk), 2 (expected utility), and 3 (uncertainty) cover most of the interpretations in which risk has been used in government and defence policies and military doctrine, while using distinct, but accessible, terminology.[3] In cases in which the term *risk* is used to refer to either probability or loss, efforts should be taken to reframe the discussion of the relevant events using the more transparent, and less emotionally evocative, terms. For instance, instead of saying that there is a 10% risk of mission failure, one could instead say that there is a 10% probability of mission failure. In this manner, policy makers, managers, and other decision makers can begin to move toward standardizing their lexicon of terms, while differentiating concepts that are each important for reaching effective decisions.

[3] Note that the risk-uncertainty distinction proposed here differs from the sense in which these terms have been employed in the decision sciences. In much of the academic literature, decisions are said to be made under conditions of risk when (a) at least one option from a set of considered options has multiple and mutually exclusive possible outcomes associated with it and (b) the probabilities of all possible outcomes for all options in the considered set are known *a priori.* Decisions are said to be made under conditions of *uncertainty* when condition (a) in the preceding definition is met, but the probability of at least some of the possible outcomes associated with one or more of the considered options is unknown or unknowable. This distinction traces back to Frank H. Knight, Risk, Uncertainty, and Profit, Boston, M.A.: Houghton Mifflin, Co., 1921, available at [http://www.econlib.org/library/Knight/knRUP0.html].

References

[1] Canada, Government of, Privy Council Office, (2000) Risk Management for Canada and Canadians: Report of the ADM Working Group on Risk Management. Ottawa, Canada.

[2] Canada, Government of, Treasury Board of Canada Secretariat, (2000) Results for Canadians: A Management Framework for the Government of Canada. Ottawa, Canada.

[3] Canada, Government of, Treasury Board of Canada Secretariat, (2001) Integrated Risk Management Framework. Ottawa, Canada.

[4] Canada, Government of, Department of National Defence, (2001, April) VCDS Letter to Level 1's," Ottawa, Canada, p.1.

[5] [http://www.vcds.forces.gc.ca/dgsp/pubs/rep-pub/dda/cosstrat/isrm/vcdsLetr_e.asp].

[6] Canada, Government of, Department of National Defence, (2004, January) 1000-6-4 (CRS), Baseline Study: Integrated Risk Management within the DND/CF. Ottawa, Canada, p. 14.

[7] Ibid., p. 15.

[8] Canada, Government of, Department of National Defence, (2005, October) Integrated Risk Management Policy, Ottawa, Canada.

[9] Canada, Government of, Department of National Defence, (2005, October) Integrated Risk Management Guidelines, Ottawa, Canada.

[10] Canada, Government of, Department of National Defence, (2005, October) Integrated Risk Management Policy, Ottawa, Canada, p. 2.

[11] Canada, Government of, Treasury Board of Canada Secretariat, (2001) Integrated Risk Management Framework. Ottawa, Canada, p. 7.

[12] Ibid., p. 6.

[13] Fischhoff, B. (1994). What forecasts (seem to) mean. *International Journal of Forecasting, 10(2),* 387-403.

[14] Kaplan, S. (1997). The words of risk analysis. *Risk Analysis, 17,* 489-498.

[15] Dowie, J. (1999). Against risk. *Risk, Decision and Policy, 4(1),* 57.

[16] Kahneman, D. & Tversky, A. (1982). Variants of uncertainty. *Cognition, 11(2),* 143-157.

[17] Kahneman, D. & Tversky, A. (1979). Prospect theory: An analysis of decision under Risk. *Econometrica, 47(2),* 236-292.

[18] Fischhoff, B., Slovic, P. & Lichtenstein, S. (1978). Fault trees: Sensitivity of estimated failure probabilities to problem representation. *Journal of Experimental Psychology: Human Perception and Performance, 4(2),* 330-344.

[19] International Organization for Standardization and International Electrotechnical Commission, ISO/IEC Guide 73, (2002) Risk Management – Vocabulary – Guidelines for Use in Standards. Geneva, Switzerland.

[20] Ibid., p. 2.

[21] Fischhoff, B., Slovic, P. & Lichtenstein, S. (1978). Fault trees: Sensitivity of estimated failure probabilities to problem representation. *Journal of Experimental Psychology: Human Perception and Performance, 4(2),* 330-344.

[22] Fischhoff, B. (1994). What forecasts (seem to) mean. *International Journal of Forecasting, 10(2),* 387-403.

[23] Canada, Government of, Treasury Board of Canada Secretariat, (2001) Integrated Risk Management Framework. Ottawa, Canada, p. 5.

[24] Hill, S. & Dinsdale, G. (2001). A Foundation for Developing Risk Management Learning Strategies in the Public Service," Canada, Government of, Canadian Centre for Management Development, Ottawa, Canada, p.5.

[25] Canada, Government of, Health Canada, (2003, June) "Strategy to Implement and Integrated Risk Management Framework in Health Canada," Ottawa, Canada, p. 4.

[26] Canada, Government of, Department of National Defence, (2001, April) VCDS Letter to Level 1's," Ottawa, Canada, p.1.

[27] Canada, Government of, Department of National Defence, (2005, October) Integrated Risk Management Guidelines, Ottawa, Canada, p. 2.

[28] Ibid., p. 7.

[29] Canada, Government of, Department of National Defence, (2002) Joint Doctrine Manual B-GJ-005-502/FP-000, Risk Management for CF Operations. Ottawa, Canada.

[30] Ibid., p. 1-1.

[31] Ibid., p. 1-2.

[32] Ibid., p. 1-5.

[33] Canadian Standards Association, CAN/CSA-Q-850-97, (October, 1997) Risk Management: Guideline for Decision-Makers. Etobicoke, Canada, p. 3.

[34] International Organization for Standardization and International Electrotechnical Commission, ISO/IEC Guide 73, (2002) Risk Management – Vocabulary – Guidelines for Use in Standards. Geneva, Switzerland, p. 2.

List of symbols/abbreviations/acronyms/initialisms

CF	Canadian Forces
CSA	Canadian Standards Association Forces
DND	Department of National Defence
DND/CF	Department of National Defence and the Canadian Forces
COA	Course of Action
GOC	Government of Canada
HR	Human Resources
ISO/IEC	International Organization for Standardization and the International Electrotechnical Commission
ISRM	Integrated Strategic Risk Management
IRM	Integrated Risk Management
IRFM	Integrated Risk Management Framework
R = EU	Risk as Expected Utility
R = L	Risk as Loss
R = P	Risk as Probability
R = PM	Risk as the Integration of Probability and Magnitude
R = PM*	Risk as the Fault-Prone Integration of Probability and Magnitude
R = V	Risk as Variability
VCDS	Vice Chief of Defence Staff

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This report critically examines existing concepts of risk and offers recommendations for improving the definition of risk and other risk-related terms. The author highlights the fact that the concept of risk is problematic because it is ambiguous and vague. In the vernacular, risk has multiple meanings including (a) risk as potential loss, (b) risk as a probability of a negative event occurring, and (c) risk as variability, volatility, or uncertainty regarding events in the future. In addition, many organisational definitions of risk define the concept in terms of an integration of the probability of a threat and the severity of its potential consequences. The author examines the definition of risk promulgated by (a) the Government of Canada through the Treasury Board Secretariat in its 2001 Integrated Risk Management Framework, (b) the Department of National Defence and Canadian Forces (DND/CF) through the 2002 Joint Doctrine on Risk Management for CF Operations and the 2005 Integrated Risk Management Guideline and Policy documents, and (c) the Canadian Standards Association (CSA) and the International Organization for Standardization and International Electrotechnical Commission (ISO/IEC). The report concludes with recommendations for the definition of risk, expected utility, and uncertainty, which the author proposes form a set of concepts that can contribute to effective decision making in defence and security contexts.

Ce rapport examine **d'un œil** critique les concepts du risque actuels et présente des recommandations afin d'améliorer la définition du risque et d'autres termes liés aux risques. L'auteur souligne le fait que le concept du risque est problématique parce qu'il est ambigu et vague. Dans le langage quotidien, le risque a de multiples significations : (a) le risque comme la perte possible; (b) le risque comme la probabilité d'un résultat négatif; (c) le risque comme la variabilité, la volatilité ou l'incertitude à l'égard de cas futurs. De plus, de nombreuses définitions organisationnelles du risque définissent le concept selon l'intégration de la probabilité d'une menace et de la gravité de ses répercussions possibles. L'auteur examine la définition du risque publiée par (a) le gouvernement du Canada dans le Cadre de gestion intégrée du risque de 2001 par le Secrétariat du Conseil du Trésor du Canada, (b) de la doctrine interarmées sur la gestion du risque pour les opérations des FC de 2002 et les documents de politique et les directives de l'intégration de la gestion du risque de 2005 du ministère de la Défense nationale et des Forces canadiennes et (c) de l'Association canadienne de normalisation (CSA) et l'Organisation internationale de normalisation (ISO) et la Commission électrotechnique internationale (CEI). La conclusion du rapport présente des recommandations pour la définition du risque, la fonction d'utilité, et l'incertitude, pour lesquelles l'auteur propose un ensemble de concepts qui favorisent un processus efficace de prise de décision dans des contextes de défense et de sécurité.

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