

Risk Perception in Multi-Domain Operations

A Monograph

by

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2021

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 23 05 21		2. REPORT TYPE MASTER'S THESIS		3. DATES COVERED (From - To) JUNE 20-MAY 21	
4. TITLE AND SUBTITLE Risk Perception in Multi-Domain Operations				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) MAJ Jeremy M. Phillips				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, KS 66027-2301				8. PERFORMING ORG REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) ADVANCED MILITARY STUDIES PROGRAM				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution is Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT From the study of cognition, the concept of "risk perception" offers insight into how risk management personnel (usually the staff or subject matter experts) and risk decision-makers (often commanders) can evaluate risk analysis methods. Risk perception, the subjective judgement of risk levels, is an idea in stark contrast to the idea that presenting facts and data is necessarily convincing. Risk perception studies have demonstrated the importance of context, narrative, and simplicity in the communication of risk. In the risk decision-maker, unfamiliarity, innumeracy, and deeply held biases or fears can result in a perceived level of risk far from that of experts. Three additional methods of risk analysis are compared to the Army doctrinal risk gradient. Derived from civilian methods, these tools are used in project management, engineering, and other risk and foresight related fields. They are fault trees, scenarios, and risk triplets. Although they all have some quantitative elements, they offer just as much if not more room for risk management personnel to apply critical thinking and share context such as uncertainty in forecasting or linkages to the planned operation.					
15. SUBJECT TERMS Risk, Risk Management, Multi Domain Operations, Future Warfare, Heuristics and Biases					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT (U)	18. NUMBER OF PAGES 46	19a. NAME OF RESPONSIBLE PERSON MAJ Jeremy M. Phillips
a. REPORT (U)	b. ABSTRACT (U)	c. THIS PAGE (U)			19b. PHONE NUMBER (include area code) 913 758-3300

Monograph Approval Page

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Monograph Title: Risk Perception in Multi-Domain Operations

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Abstract

The cognitive demands on commanders are increasing. Due to the speed of innovation and change, commanders' ability to make good risk decisions are challenged. Future warfare is unlikely to resemble previous conflicts or training exercises that focus on a conventional fight. US adversaries avoid using set doctrine in order to present unforeseen hazards which are difficult to anticipate or mitigate. Given that a commander must not merely avoid risk, but accept it to gain and maintain the initiative in war, commanders and their staffs should consider whether the Army's risk doctrine and the doctrinal risk gradient method at the center of Army risk management are sufficient for future warfare as described in the concept of multi-domain operations.

From the study of cognition, the concept of "risk perception" offers insight into how risk management personnel (usually the staff or subject matter experts) and risk decision-makers (often commanders) can evaluate risk analysis methods. Risk perception, the subjective judgement of risk levels, is an idea in stark contrast to the idea that presenting facts and data is necessarily convincing. Risk perception studies have demonstrated the importance of context, narrative, and simplicity in the communication of risk. In the risk decision-maker, unfamiliarity, innumeracy, and deeply held biases or fears can result in a perceived level of risk far from that of experts.

Three additional methods of risk analysis are compared to the Army doctrinal risk gradient. Derived from civilian methods, these tools are used in project management, engineering, and other risk and foresight related fields. They are fault trees, scenarios, and risk triplets. Although they all have some quantitative elements, they offer just as much if not more room for risk management personnel to apply critical thinking and share context such as uncertainty in forecasting or linkages to the planned operation.

As described in Army publications and articles, future warfare is expected to require commanders to master five domains – including the unfamiliar cyber and space domains – in areas of operation that tend to be vaster than previous, in operations trending toward increased speed of maneuver and innovation. In such an environment, whether in competition, conflict, counter-insurgency, or large-scale ground combat, all military professionals should use the best possible risk analysis to preserve lives and achieve objectives. To that end, this paper recommends possible changes to doctrine, leader development, and staff operations.

Contents

Abstract	iii
Contents.....	iv
Acknowledgements	vi
Abbreviations	vii
Figures.....	viii
Introduction	1
Introduction	1
Problem Statement	2
Significance	3
Research Approach.....	3
Definition of Terms	4
Overview of Hypothesis	5
Delimitations	5
Risk, Risk Doctrine, and Multi-Domain Operations	6
Risk and Probability	6
US Risk Doctrine and the Risk Gradient.....	8
Multi-Domain Operations	14
Risk Perception.....	16
Risk Analysis Tools.....	19
Possible Shortfalls of the Risk Gradient.....	19
Fault trees / Event trees	21
Scenarios	22
Risk triplets.....	24
Impact of Different Risk Analysis Tools on Risk Perception in MDO.....	27
Analysis	29

Research Question: How does risk perception affect decision-making in multi-domain operations?.....	29
Secondary Research Questions.....	33
Conclusion.....	38

Acknowledgements

I could not have completed this paper without the excellent guidance and feedback from my monograph director, Dr. Greer. Thank you for your support, sir.

Concepts from the rest of the curriculum helped me reach my conclusions, so thanks to all the faculty that instructed Seminar 7 this year: Dr. Smith, Dr. Stanley, Dr. Calhoun, Dr. Meuhlbauer, and Dr. Curatola. I also benefited from Dr. Butler-Smith's creativity in designing the Great Powers Perspective course and her thoughtfulness and patience in instructing the "Turkey" class. COL Prandtner, thank you for the many lessons you imparted on briefing, writing, fighting, and teamwork. This year has been a pleasure.

Finally, shout out to my wife Maggie and my kids for their patience when I stayed in the classroom or shut myself into the office to work on this or other SAMS assignments. I love you guys, thanks for your patience and support.

Abbreviations

ADP	Army Doctrinal Publication
AO	Area of Operations
ATP	Army Techniques Publication
CGSS	Command and General Staff School
DA PAM	Department of the Army Pamphlet
FM	Field Manual
HB	Heuristics and Biases
KSAs	Knowledge, Skills, and Abilities
MDMP	Military Decision-Making Process
MDB	Multi Domain Battle
MDO	Multi Domain Operations
NASA	National Aeronautics and Space Association
NDM	Naturalistic Decision Making
RM	Risk Management
SAMS	School of Advanced Military Studies
SCP	School of Command Preparation
TRADOC	Training and Doctrine Command
TP	TRADOC Pamphlet

Figures

Figure 1. Joint Risk Management Process.	10
Figure 2. Army Risk Management Cycle.....	11
Figure 3. Comparison of Joint and Army risk classification.....	12
Figure 4. Military Risk Contour and Military Risk Tables	13
Figure 5. Risk Management in the Military Decision Making Process.....	17
Figure 6. Example Fault Tree.....	21
Figure 7. Risk as an Aggregate Set of Risk Triplets.	25
Figure 8. Categories of Risk Assessment Methods and Products	34
Figure 9. Depiction of Psychometric Paradigm.....	36

Introduction

The Allied campaign in the Mediterranean during World War II was, from the beginning, a gigantic calculated risk.

Churchill was ready to accept the obvious hazards of the landing because the prize to be gained by seizing Rome justified a calculated risk.

—General Mark W. Clark, *Calculated Risk*

Introduction

Analyzing risk has always been an implicit component of military decision-making.

Alexander the Great, who physically led his troops into battle, must have known viscerally the possible danger of each campaign and battle. Napoleon Bonaparte said in 1813 “if the art of war were nothing but the art of avoiding risks, glory would become the prey of mediocre minds.... I have made all the calculations; fate will do the rest.”¹ In World War II, Allied military commanders echoed Napoleon’s emphasis on calculation, for instance in a famous cable from Admiral Nimitz to his subordinate commanders urging them to “be governed by the principle of calculated risk.”² Army commanders acknowledged the same principle, as in General Mark Clark’s memoir of the Italian campaign which is titled *Calculated Risk* and frames key decisions in terms of calculation rather than more subjective terms like perception.³

Whether Napoleon meant he actually used pencil-and-paper calculations, or was referencing a more qualitative sense of his army’s potential, the probabilistic analysis has come to define the US Army’s approach to risk analysis. Due to the changing character of war, it may be

¹ J. Christopher Herold, *The Mind of Napoleon* (New York: Columbia University Press, 1965), 45.

² US Naval War College, “Command Summary of Fleet Admiral Chester W. Nimitz, USN: Volume 1 of 8; Running Estimate and Summary Maintained by Captain James M. Steele, USN, CINCPAC Staff at Pearl Harbor, Hawaii, Covering the Period 7 December 1941 to 31 August 1942,” U.S. Naval War College Naval Historical Collection, p. 490, usnwc.edu/Academics/Library/Naval-Historical-Collection.aspx#items/show/840.

³ Mark W. Clark, *Calculated Risk* (New York: Harper & Brothers Publishers, 1950).

time to reevaluate the Army's approach to risk, using available research on risk perception and cognition to suggest new ways to support risk decision-making.

Problem Statement

The Army's focus on risk has changed since the 1980s, resulting in a process for risk analysis that relies on previous experience to present a chart with risk expressed as a static equation using probability and severity. This approach is at odds with the changing character of war best expressed by the Army's Multi-Domain Operations concept. In the current and future operational environment (OE), the speed of technological innovation, increasing complexity of joint and multinational formations, and unpredictable deployments to unfamiliar locations will challenge the staff's ability to provide good inputs to the "risk gradient" method. In addition, commanders in an unfamiliar operational environment would benefit from risk analysis, risk communication, and graphic depictions of risk that provide rich context and acknowledges uncertainty, rather than a probabilistic snapshot that provides the impression of scientific analysis.

The future OE and cognitive requirements of MDO will challenge the risk perception of Army leaders. Risk perception is "the subjective judgement that people make about characteristics and severity of risk."⁴ One of the challenges to risk perception is unfamiliarity with a problem, domain, or situation.⁵ According to the Army MDO concept, unfamiliarity is likely to be more frequent and pronounced in future conflicts. Inappropriate risk perception due to cognitive and psychological deficiencies may have negative effects on decision-making.

⁴ "Risk Perception," Wikipedia, last modified 23 March 2020, https://en.wikipedia.org/wiki/Risk_perception. This definition is more precise and descriptive than Paul Slovic's definition of "perception" as "various kinds of attitudes and judgments" in *The Perception of Risk*, xxxvii, but in context it is clear that Wikipedia's description fits the phenomenon described by Slovic.

⁵ Paul Slovic, *The Perception of Risk* (London: Earthscan, 2000), 182-198.

Significance

In the Army, risk analysis or risk communication do not exist for their own sake, they have to support decision-making. Commanders decide what risk to accept, what to mitigate, and what to avoid. In familiar environments, with organic equipment, they rely on experience and intuition (which is subconscious judgment based on experience). The changing character of war suggests that commanders will continue to encounter unfamiliarity, causing them to rely on the analysis and communication of their staffs and experts. It is worth examining, then, the risk analysis method contained in doctrine.

Even in a controlled, measurable environment such as an engineering project, leaders and their supporting experts or staffs have to make subjective decisions. Risk perception is a field of study that examines how and why different decision-makers or populations react differently to hazards. Facts alone do not determine how people will react to hazards, since two people may react to the same facts in different ways based on their biases, priorities, and experiences. Although it is sometimes difficult to say whose choice was “right” and “wrong,” for instance when a low probability of winning pays off and a near-sure thing fails, any risk analysis method should be evaluated based on support to effective risk perception.

Research Approach

Research will focus on a theoretical approach supplemented with doctrine and emerging operational concepts to evaluate risk analysis methods. The concept of risk perception will serve as a means to subjectively evaluate risk analysis methods for their suitability. Research will evaluate risk analysis methods from engineering, project management, and other fields, and recommend the implementation of appropriate methods into MDO decision-making. Studies on risk perception and its role in decision-making will inform the approach to doctrine, as well as frame historical case studies or vignettes. Key doctrinal publications for this monograph to

consider include Army and Joint doctrine on multi-domain operations, all-domain operations, and risk.

Definition of Terms

Bias: a tendency in decision-making or perception-forming due to reliance on a heuristic.

Heuristics: “principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations”⁶

Intuition: “use of experience to recognize key patterns that indicate the dynamics of the situation”⁷

Multi-domain operations: military concept characterized by three tenets, “calibrated force posture, multi-domain formations, and convergence”⁸

Risk: “Probability and severity of loss linked to hazards”⁹

Risk assessment: The identification and assessment of hazards (first two steps of risk management process)¹⁰

Decision making: a continuous process conducted by commanders to “carefully balance priorities between current and future operations as part of controlling risk”¹¹

⁶ Daniel Kahneman, Paul Slovic, and Amos Tversky, *Judgment Under Uncertainty* (Cambridge; Cambridge University Press, 1982), 3.

⁷ Klein, Gary, *Sources of Power*. Quoted in US Department of the Army, Army Doctrine Publication (ADP) 6-0, *Mission Command* (Washington, DC: Government Publishing Office), 2-5.

⁸ US Army Training and Doctrine Command (TRADOC), TRADOC Pamphlet 525-3-1, *The US Army in Multi-Domain Operations 2028* (Fort Eustis, VA: TRADOC, 6 December 2018), vii.

⁹ US Department of the Army, Army Techniques Publication (ATP) 5-19, *Risk Management* (Washington, DC: Government Publishing Office, 2019), Glossary-3.

¹⁰ US Army, ATP 5-19, Glossary-3.

¹¹ US Department of the Army, Army Doctrinal Publication (ADP) 3-0, *Operations* (Washington DC: Government Publishing Office, 2019), 4-6.

Risk perception: “The subjective judgement that people make about characteristics and severity of risk.”¹²

Overview of Hypothesis

Army risk analysis doctrine’s probabilistic method does not provide the best support to the commander’s decision-making in MDO, and other methods from science or industry may be more appropriate in light of the idea of “risk perception” or subjective judgements of risk. The current Army process does not acknowledge the uncertainty and biases that exist in risk analysis, and the final product presents a static snapshot of potential risk that is cognitively separate from course of action development. Methods that present more context to the risk analysis through narrative, graphical depiction that show potential courses of action, or otherwise demonstrate the progress through time and subsequent actions will be better aids to effective risk perception than the current doctrinal method, although they may have drawbacks such as requiring more time, being more complex, or being harder to reproduce.

Delimitations

This monograph will focus on the Army multi-domain operations concept. All branches of the US military are developing related concepts of multi-domain and all domain operations and command and control. The findings of this paper have some relevance to all services and some civilian functions. The implications, however, focus primarily on an Army audience.

¹² “Risk Perception,” *Wikipedia*, https://en.wikipedia.org/wiki/Risk_perception, last modified 23 March 2020.

Risk, Risk Doctrine, and Multi-Domain Operations

Modern methods of dealing with the unknown start with measurement, with odds and probabilities. But where did the numbers come from?

—Peter L. Bernstein, *Against the Gods: The Remarkable Story of Risk*

Risk and Probability

Risk as a field of study originated in games of chance. Humans have apparently always gambled, but for centuries players considered the outcomes to be the will of gods or unknowable fortune.¹³ Probabilistic understanding of the odds in such situations began with the work of Blaise Pascal and Pierre de Fermat, and has continually increased in complexity.¹⁴ Many mathematical puzzles and thought experiments with impacts on other fields started with the “problem of points,” a type of word problem based on determining how to divide the stakes of a game in progress, based on each player’s chances of winning. These gambling-centered problems, which collectively considered “the problem of points” brought the understanding of risk “to the threshold of quantification of risk.”¹⁵

Risk, like gambling, cannot be reduced entirely to equations because players, faced with similar or even the same predictable, quantifiable odds, make different decisions. Acknowledging the unique decisions of players in games of chance, researchers have studied the subjective judgement required even in informed decision-making. Ellen Peters and Paul Slovic have both studied how the presentation of data affects decision-makers. Presented with the same probabilities, individuals perceive risk differently based on past experiences, cognitive limitations, and how the data is presented.¹⁶ This can arise from misunderstanding, reliance on

¹³ Peter L. Bernstein, *Against the Gods: The Remarkable Story of Risk* (New York: John Wiley & Sons, 1996), 11-22.

¹⁴ Bernstein 1996, 11-22.

¹⁵ Bernstein 1996, 43.

¹⁶ Paul Slovic, *The Perception of Risk* (London: Earthscan, 2000), xxxi.

“good stories” within the data or emotional responses on the part of the decision-makers. These reactions can be more impactful in decision-makers that are less numerate.¹⁷ Even in highly numerate decision-makers, context and framing changes how people perceive percentages and probabilities. This is clear in the example of “prospect theory.” Prospect theory describes how decision-makers are more willing to take a chance on a small possibility of gains, but are risk-averse with regard to a small possibility of loss.¹⁸ This subjective reaction to risk is called “risk perception,” and it combines the use of probabilities, previous experience, context, and cognition to examine risk decision-making.

Researchers once considered risk perception to be “a form of deliberative, analytic information processing,” but the consensus today is that “emotional and affective processes” play a large, even governing part.¹⁹ Evidence suggests that, while experts making decisions within their fields make risk decisions based on evidence, non-experts or laypeople make quantitative risk judgements about hazards based on non-credible estimates. Properties such as “catastrophic potential, threat to future generations,” dread, and uncertainty have much more impact on non-experts than experts.²⁰ Even within a practitioner’s general field, such as medicine for a doctor, the way data is presented can significantly change the way that decision-makers judge risk.²¹ Therefore, risk perception is closely linked to the cognitive processes used to make judgements, and any risk analysis tools or methods should consider risk perception in terms of the underlying cognition.

Two approaches to judgement and decision-making that consider how the mind encounters probabilities, how it can be fooled, and how previous experiences improve or degrade

¹⁷ Ellen Peters. *Innumeracy in the Wild* (New York: University of Oxford Press, 2020), 17.

¹⁸ Kahneman 2011, 281-285.

¹⁹ Slovic 2000, xxxi.

²⁰ Slovic 2000, 223-224.

²¹ Only 9% of American adults are at the highest level of numeracy; even holders of PhD and MD qualifications can be decidedly innumerate. Peters 2020, 5-8.

decision-making are heuristics and biases (HB) and naturalistic decision-making (NDM). HB considers two categories of mental processes; system 1 and system 2. System 1 is governed by heuristics, shortcuts or rules of thumb, tricks which are necessary to operate in everyday life but have the potential to deceive us. System 2 is deliberate and effortful, and is required in new, illusive, or confusing situations.²² NDM counts on the mind to quickly reach good decisions based on intuition in most situations.²³ In a joint paper between the preeminent theorist for each approach, Daniel Kahneman (representing the HB approach) and Gary Klein (representing the NDM approach) concluded that they had much in common, and that intuition is most effective when it can be honed through repetition and when the rules of the game are static.²⁴

The importance of supporting decision-making in even the earliest examinations of risk suggests that doctrinal tools should also focus on the decision-maker. Advancements in risk perception studies demonstrate that probabilities are not the only thing that decision-makers need, and that how probabilities and other data are presented can change how that information is used. Understanding cognition suggests that in some situations, particularly unfamiliar ones, intuition will be challenged and decision-makers will have to engage in conscious and effortful evaluation of facts to avoid overreliance on heuristics or prejudice from biases.

US Risk Doctrine and the Risk Gradient

The Army's doctrine regarding risk is not developed specifically to support risk perception and account for System 1 and System 2 thinking. The integration of "risk" into US Army doctrine as an essential requirement of military planning at all is relatively new. The 1986 FM 100-5 mentioned risk only once, stating that "the need to have sufficient force available to

²² Daniel Kahneman, *Thinking, Fast and Slow* (New York; Farrar, Straus and Giroux, 2011).

²³ Daniel Kahneman and Gary Klein, "A Failure to Disagree," *American Psychologist* 64, No. 6, (September 2009): 515-526. <https://doi.org/10.1037/a0016755>.

²⁴ Kahneman and Klein 2009, 520.

exploit success, imply accepting risk elsewhere.”²⁵ 1998 FM 100-14 introduced a linear process “conserve combat power and resources.” In 2006, FM 5-19, clarified standards and guidance, renamed to “composite risk management.”²⁶ Today, the Army uses a “holistic” approach rather than distinguishing between tactical and accidental risk.²⁷ Army doctrine generally mirrors Joint doctrine, with more emphasis on the information or intelligence available and the same focus on the simple, linear process.

In operational planning, the Army primarily uses ADP 3-0, ADP 5-0, and FM 3-0. These publications state that the commander has to “understand, balance, and take risks” in order to achieve mission success.²⁸ Given that “risk is inherent in all operations,” the commander and staff use the risk management process (which is the same in Joint and Army doctrine) to “balance risk cost with mission benefits.”²⁹ Although the technical process of the risk management process is not described in these doctrinal publications, Annex B of FM 3-0 provides an initial list of questions that suggests that risk can be affected by the enemy’s decisions (such as where the enemy reserve is located), the position of key leaders, and the staff’s synchronization and self-examination.³⁰

To support the commander’s risk decision-making, the Army describes the “risk management” process that considers “composite risks from all sources.”³¹ This technical, process-oriented approach to risk assessment uses probability and severity to categorize risk

²⁵ US Army, Field Manual (FM) 100-5, *Operations* (Washington, DC: Government Printing Office, 1986), 94.

²⁶ US Department of the Army, Army Techniques Publication (ATP) 5-19, *Risk Management* (Washington DC: Government Publishing Office, April 2014), v.

²⁷ US Army, ATP 5-19, v.

²⁸ US Department of the Army, Field Manual (FM) 3-0, *Operations* (Washington DC: Government Publishing Office, December 2017), B-1.

²⁹ US Department of the Army, Army Doctrinal Publication (ADP) 5-0, *The Operations Process* (Washington DC: Government Publishing Office, July 2019), 1-17.

³⁰ US Army, FM 3-0, B-1 – B-2.

³¹ US Army, ATP 5-19, v.

levels from both tactical and accidental risk.³² The Army process generally mirrors the Joint process, a five-step Joint Risk Framework and Risk Management.³³ This approach uses probability and consequence to evaluate and communicate risk, using quantitative elements of analysis to define the “boundaries” of broad categories. The end result of the Risk Management process is a risk gradient or risk quadrant, which the commander and staff can use to support further decision-making with regard to risk acceptance, mitigation, or avoidance.

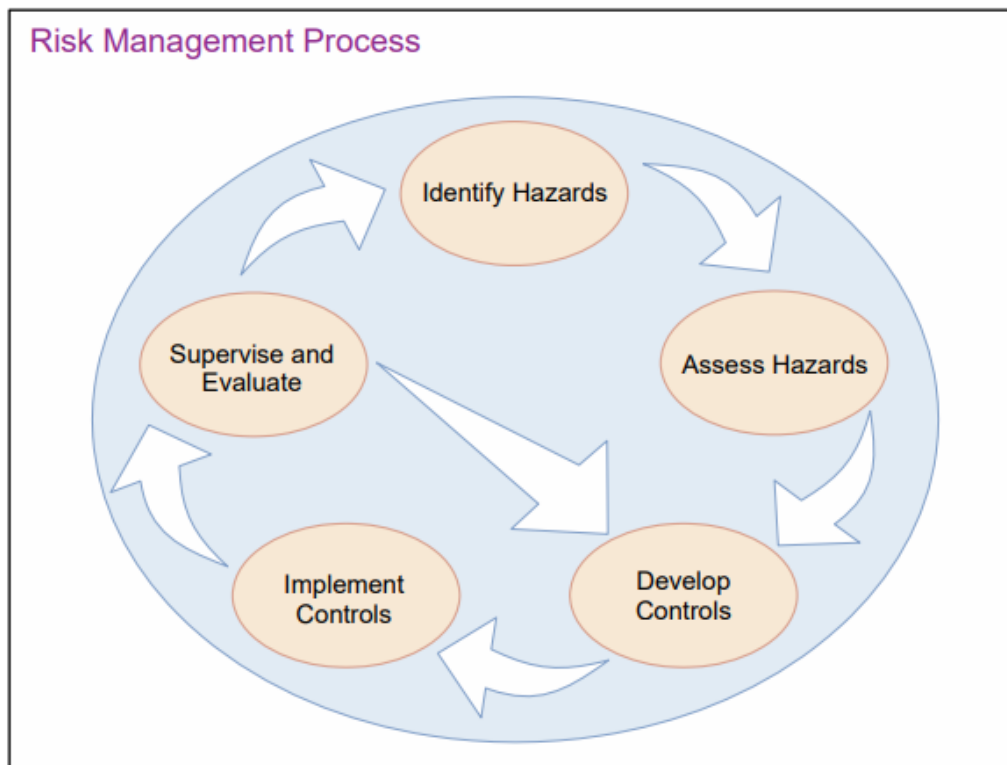


Figure III-3. Risk Management Process

III-16

JP 3-0 CHI

Figure 1. Joint Risk Management Process. US Department of Defense, Joint Staff, Joint Publication (JP) 3-0, *Joint Operations* (Washington, DC: Government Publishing Office, 2017), III-16.

³² US Department of the Army, Department of the Army Pamphlet (DA PAM) 385-30, *Risk Management* (Washington DC: Government Publishing Office, December 2014), 6-8.

³³ US Department of Defense, Joint Staff. Joint Publication (JP) 3-0, *Joint Operations* (Washington DC: Government Publishing Office, October 2018), III-16.

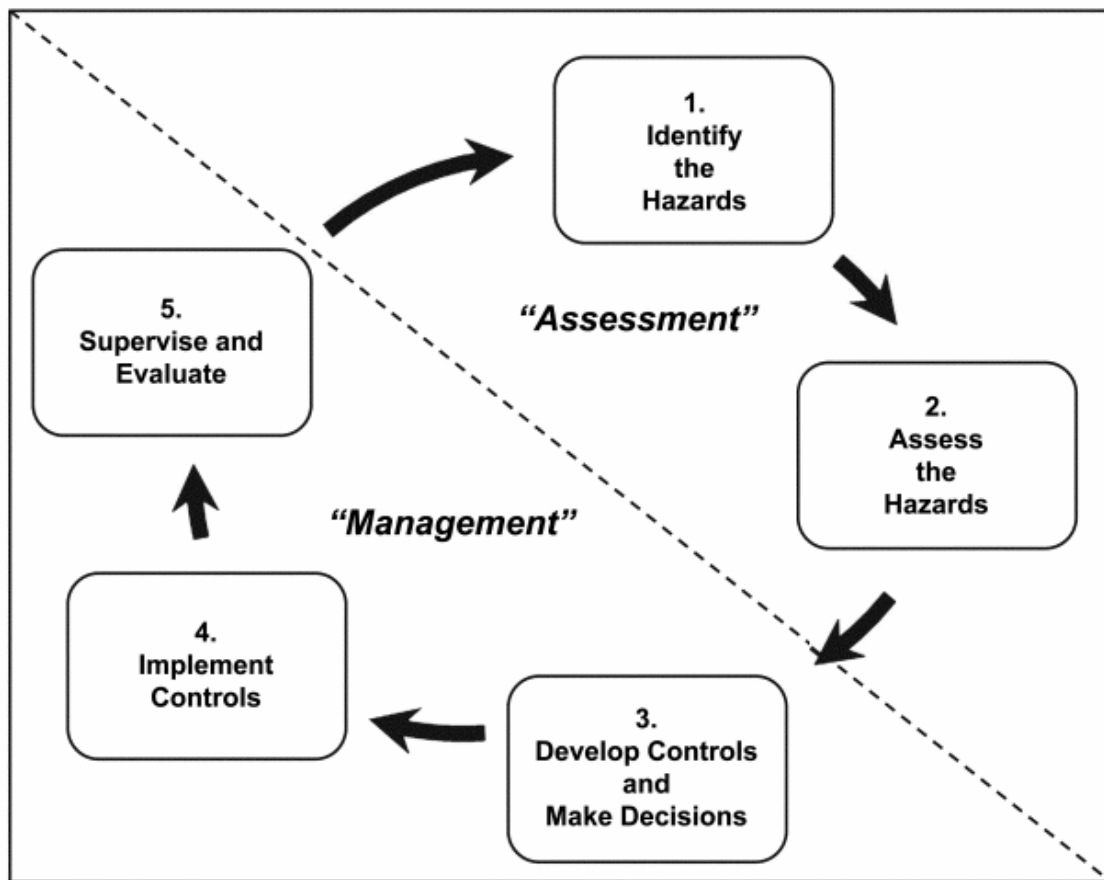


Figure 1-2. Five-step cycle of risk management

Figure 2. Army Risk Management Cycle. US Department of the Army, Department of the Army Pamphlet (DA PAM) 385-30, *Risk Management* (Washington DC: Government Publishing Office, December 2014), 4.

Joint	Army
Levels of consequence	Severity
Minor harm to something of value	Catastrophic
Moderate harm to something of value	Critical
Major harm to something of value	Moderate
Extreme harm to something of value	Negligible

Joint	Army
Probability of Event	Probability
Highly unlikely (~0-20%)	Frequent (continuous, regular, or inevitable occurrences)
Improbable (~21-50%)	Likely (several numerous occurrences)
Probable (51-80%)	Occasional (Sporadic or intermittent occurrences)
Very likely (~81-100%)	Seldom (Infrequent occurrences)
	Unlikely (Possible occurrences but improbable)

Figure 3. Comparison of Joint and Army risk classification. Created by author. US Department of Defense, Joint Staff, Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3105.1, *Joint Risk Analysis* (Washington, DC: Government Publishing Office, 2016). US Department of the Army, Department of the Army Pamphlet (DA PAM) 385-30, *Risk Management* (Washington DC: Government Publishing Office, December 2014).

The cornerstone of Army and Joint risk management today is the risk gradient (or risk contour). This is the method by which a staff or analyst categorizes risk from individual hazards after the staff has identified the hazards to determine which has the highest overall risk.

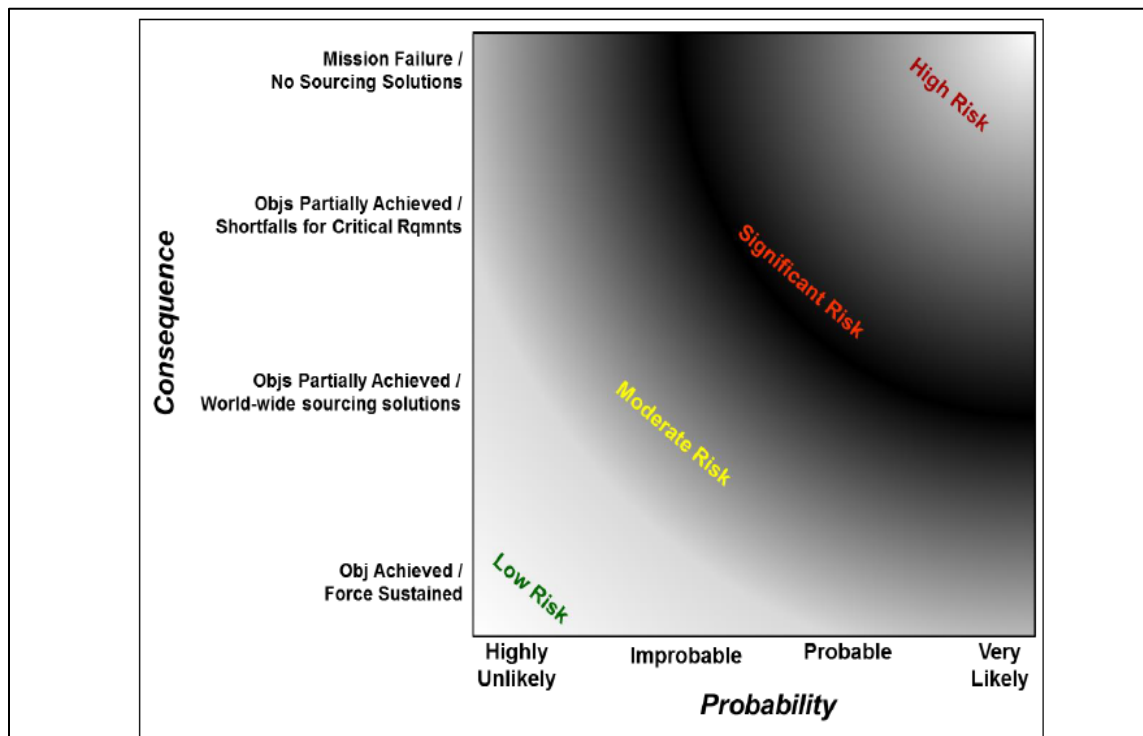


Figure 13. Military Risk Contour

Probability of Event (P)	Consequence of Event (C)
Highly Unlikely (~0-20%)	• Mission Success, Objectives Achievable
Improbable (~21-50%)	• Joint Force Fully Sustained and Requirements Sourced
Probable (~51-80%)	• Objectives Partially Achieved (consider time, priority) • Worldwide Sourcing Solutions Exist for Most Requirements
Very Likely (~81-100%)	• Objectives Partially Achieved (consider time, priority) • Shortfalls Exist for Critical Requirements • Mission failure, Objectives Unachievable • No Sourcing Solutions Exist for Critical Requirements

Figure 4. Military Risk Contour and Military Risk Tables. US Department of Defense, Joint Staff, Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3105.1, *Joint Risk Analysis* (Washington, DC: Government Publishing Office, 2016).

The risk gradient simplifies risk down to a simple, unambiguous table and a formulaic determination of risk based on probability and severity. Since military operations are not

repeatable experiments, it is impossible to objectively determine the probability of individual hazards the way a scientist or an engineer might in other fields. Recognizing that, the risk gradient only requires the staff to determine the relative probability from “Frequent” to “Unlikely” with a verbal description.³⁴ This is in contrast to Joint doctrine, which assigns a specific probability range to the probability labels from “Highly Unlikely (~0-20%)” to “Very Likely (~80-100%).”³⁵

The risk gradient also requires an estimate of each hazard’s severity, using a verbal description as well. These range from “Catastrophic” to “Negligible.” Although this method is applicable for any type of risk, for training and garrison operations the five categories of severity are defined in quantitative terms to match with the Class A through D accident categories.³⁶ A qualitative definition is also provided, which may guide planners if they decide to create a unit- or mission-specific quantitative value.

Multi-Domain Operations

The Army anticipates the nature of warfare will remain constant, but the character of warfare will continue to change. The enduring nature of warfare is violent conflict, conducted to achieve political or ideological aims. Meanwhile, the character of warfare – its speed, connectedness, global impact, and dependence on high technology solutions – continues to change. One way the Army describes the anticipated future character of warfare is in the concept of multi-domain operations (MDO).

The Army introduced MDO to describe the necessity of “rapid and continuous integration of all domains of warfare” in an era of Great Power Competition and technological innovation.³⁷

³⁴ US Army, DA PAM 385-30, 6.

³⁵ US Department of Defense, Joint Staff, Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3105.1, *Joint Risk Analysis* (Washington, DC: Government Publishing Office, 2016), B-2.

³⁶ US Department of the Army, Army Regulation (AR) 385-10, *The Army Safety Program* (Washington, DC: Government Publishing Office, 2017), 27.

³⁷ US Army, TP 525-3-1, iii.

MDO can trace its conceptual roots to the 2012 Capstone Concept for Joint Operations (CCJO).³⁸ GEN Perkins, at that time the Army TRADOC commander, made the ideas of the CCJO more concrete in a journal article he published as the Commanding General of US Army Training and Doctrine Command (TRADOC).³⁹ Those ideas also came out in an Army Training and Doctrine Pamphlet, TRADOC Pamphlet (TP) 525-3-1, *The US Army in Multi-Domain Operations*. TP 525-3-1 provides a logic chart of the concept, emphasizing the concept's focus on competition and armed conflict with China and Russia, as well as introducing the idea of "convergence."⁴⁰ Convergence, and MDO in general, are still essentially joint due to the efforts of senior military leadership to develop supporting lines of effort across the joint force.

In 2020, Chairman of the Joint Chiefs General Mark Milley assigned each service with a supporting concept for the joint version of Multi-Domain Operations, called Joint All-Domain Operations. The Air Force is responsible for JADO command and control (C2). The Navy is responsible for JADO fires. The Army's contribution to the joint concept is JADO logistics.⁴¹ It seems that the services have all accepted the necessity to think and plan in MDO terms to confront a shared vision of future warfare.

If the trends in the Army MDO concept are accurate, then MDO describes a cognitively challenging operational environment (OE). Commanders will confront an expanded battlefield presenting geographic and temporal challenges to maneuver, logistics, and communications. Enemy forces will contest all domains through asymmetric threats, and commanders will require

³⁸ US Department of Defense, Joint Staff, Capstone Concept for Joint Operations (CCJO): *Joint Force 2020* (Washington, DC: Government Publishing Office, 10 September 2012).

³⁹ David G. Perkins, "Multi-Domain Battle: Driving Change to Win in the Future." *Military Review* (July-August 2017): 6-12. https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/MilitaryReview_20170831_PERKINS_Multi-domain_Battle.pdf.

⁴⁰ US Army Training and Doctrine Command (TRADOC), TRADOC Pamphlet 525-3-1, *The US Army in Multi-Domain Operations 2028* (Fort Eustis, VA: TRADOC, 6 December 2018), v.

⁴¹ Jen Judson, "From Multi-Domain Battle to Multi-Domain Operations: Army evolves its guiding concept," *DefenseNews* (9 October 2018). <https://www.defensenews.com/digital-show-dailies/ausa/2018/10/09/from-multi-domain-battle-to-multi-domain-operations-army-evolves-its-guiding-concept/>.

new systems and paradigms to maintain US domination of air, cyber, and space. MDO will require increased joint, interagency, and multinational cooperation, introducing complexity and unfamiliar capabilities into corps and below formations. In short, it is likely that commanders and other risk decision-makers will encounter unfamiliar situations, challenging their risk perception.

Risk Perception

Risk perception is a phenomenon that spans all five steps of the Army Risk Management process, but crucially occurs in steps 1-2 (Identify the Hazards, Assess the Hazards) as the risk decision-maker or commander processes the staff's outputs and moves into step 3 (Develop Controls and Make Risk Decisions). The many decisions that unit commanders make about what hazards a plan or course of action poses and the impact of specific hazards are subjective, based on how the commander understands the risk presented to him. The way that risk is perceived is related to many factors. Individuals make different decisions about risk when considering hazards they have experienced than they do when considering hazards with which they have no personal experience.⁴² Individuals carry strong beliefs about risk and relative reward which are hard to modify.⁴³ Psychometric research has attempted to categorize the many psychological factors that come into play when individuals assess risk, demonstrating remarkable variance across populations and between experts and laypeople.⁴⁴

Because risk perception is so impactful on operational decisions, the staff should consider it during both design activities described in Army Design Methodology as well as detailed planning. Design teams already doctrinally consider risk when they formulate an operational approach.⁴⁵ In ADM, commanders and staff use operational art to integrate ends, ways, and

⁴² Slovic 2000, 66-67.

⁴³ Slovic 2000, 185.

⁴⁴ Slovic 2000, 191.

⁴⁵ Headquarters, US Army, Army Techniques Publication (ATP) 5-0.1, *Army Design Methodology* (Washington DC: Government Publishing Office, July 2015), 1-4.

means “while considering risk.”⁴⁶ ATP 5-19 describes methods for integrating risk management into MDMP and TLPs, as well as elements of risk guidance the commander should provide to influence subordinate units and the staff in planning.⁴⁷ The commander begins to make decisions based on his risk perception even before deliberate risk analysis is undertaken as he sets the level of risk that subordinate commanders may accept and emphasizes mission or operational variables for the staff to focus on.⁴⁸

Military decisionmaking process steps	Risk management steps				
	Identify the hazards	Assess the hazards	Develop controls and make risk decisions	Implement controls	Supervise and evaluate
Receipt of mission	X				
Mission analysis	X	X			
Course of action development	X	X	X		
Course of action analysis	X	X	X		
Course of action comparison			X		
Course of action approval			X		
Orders production, dissemination, and transition	X	X	X	X	X

Figure 5. Risk Management in the Military Decision Making Process. US Department of the Army, Army Techniques Publication (ATP) 5-19, *Risk Management* (Washington DC: Government Publishing Office, April 2014), 4-2.

Risk perception affects decision-making because it refers to how people, in this context commanders and staffs, understand and internalize risk information. Risk perception encompasses

⁴⁶ US Army, ATP 5-0.1, 1-5.

⁴⁷ US Army, ATP 5-19, 4-2.

⁴⁸ US Army, ATP 5-19, 4-2.

the means by which risk management practitioners initially identify hazards to analyze. The weight risk management practitioners apply to a given hazard's chances of happening and potential consequences, when they cannot be linked to predictive or forensic data, are part of risk perception. A complete risk analysis is not necessarily going to influence risk decision-making if the decision-makers (senior members of the staff and the commander) do not perceive the risk the same way as the person that completed the analysis.

Risk Analysis Tools

When success is less than a sure thing but through analysis of the salient aspects of the problem, including costs and consequences of failure, a commander decides to proceed nonetheless, we can say that he is taking a “calculated risk.”

Robert C. Rubel, 2015

Possible Shortfalls of the Risk Gradient

The risk gradient presents two challenges to risk perception, particularly in light of the cognitive challenges encountered in the future multi-domain OE. The first issue is the difficulty of communicating uncertainty using the gradient method. The second is the possibility of biasing decision-makers or failing to communicate the context of the analysis. Since the subjective evaluation of risk is so important, these possible failures of the current system bear examination.

The primary benefit of the risk gradient is the clear, definitive categorizing of hazards into a risk level using an unchanging formula. Its first drawback is that, due to its treatment of hazards as unchanging over time or in relation to changing operational objectives, there is not an obvious mechanism for the staff or risk management personnel to register lack of certainty. Methods of risk analysis that are more thorough in capturing uncertainty about a hazard’s risk level and how it may change over time might be better suited to supporting risk decision-makers in a fast, complex, and unfamiliar OE.

A related issue is the risk gradient’s possible tendency to lead the commander or risk decision-maker to over-rely on the three heuristics identified by HB theory (representativeness, availability, and anchoring/adjustment).⁴⁹ For instance, in the doctrinal risk assessment step, the risk management personnel categorize risk from a hazard without necessarily describing how the hazard’s impact changes over the course of the operation. There is not a required step to describe what information would change the risk category of a hazard, possibly inducing the availability

⁴⁹ Kahneman, Slovic, and Tversky 1982, 3.

heuristic into risk decisions. This method presents the risk category of a hazard as fixed, only thinking of them as changing risk level in response to active risk mitigation. Instead, a particular hazard may become less dangerous if it affects a unit, asset, or area that is of less importance in later phases of the operation.

For a hypothetical example, enemy cyber intelligence collection may pose a high risk in the deployment phase as soldiers' personal devices and social media posts could inform the enemy of which units are arriving in the area of operations (AO). That risk might be reduced in the dominate phase, as the enemy is expected to figure out through many other sources and through combat which US units are operating in the AO. A well-trained staff may present the risk in phase one and phase three as different, but the doctrinal method drives them to simplify, and therefore describe the risk to the commander or risk decision-maker as either high (as in phase one) or low (as in phase two).

Fault trees / Event trees

Fault trees (also called event trees) are a visual depiction of a chain of events, linking probability and consequence through the logic of consecutive events. The graphical model of a fault trees is usually accompanied by a mathematical calculation of overall probability. To construct a fault tree, an analyst or staff begins by “listing all important pathways to failure, then listing all possible pathways to these pathways, and so on.”⁵⁰ Once the fault tree has the desired granularity and each event has probability assigned, the staff calculates the “overall failure rate” of each branch.⁵¹

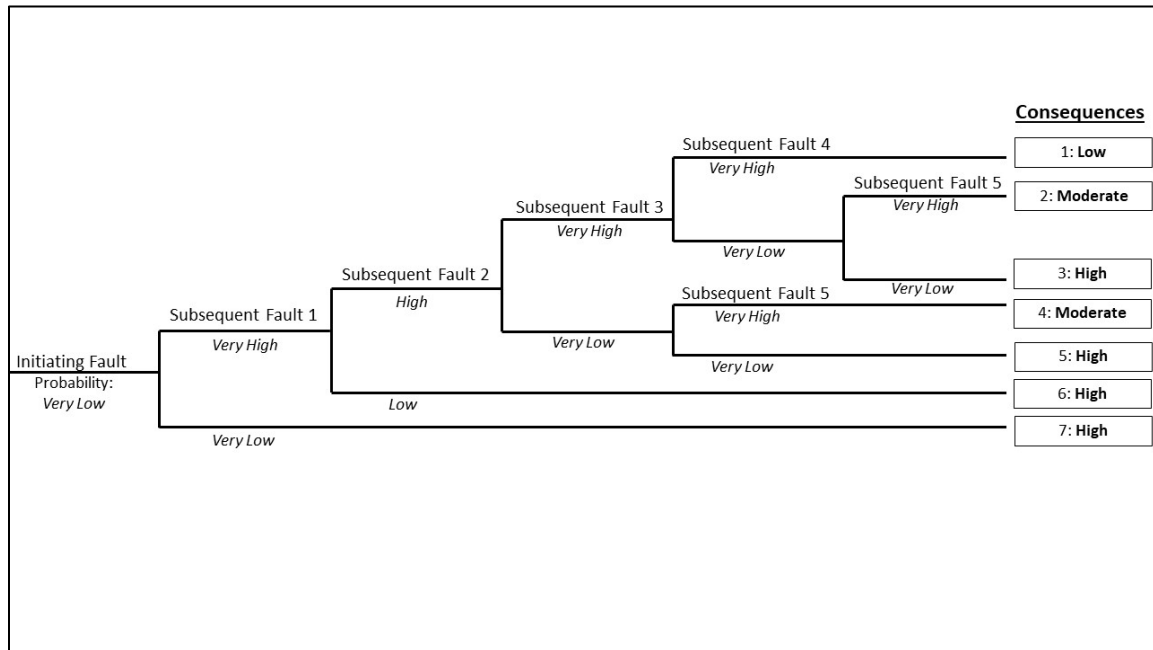


Figure 6. Example Fault Tree. Created by the author. Adapted from Rasool Kenarangui, “Event-Tree Analysis by Fuzzy Probability,” *IEEE Transactions on Reliability* 40, no. 1 (April 1991): 120-124, 121.

Once the tree is constructed, analysts calculate the “maximum probability associated with various outcomes” as well as “the grade of membership of the rating.”⁵² The challenge for

⁵⁰ Slovic 2000, 41.

⁵¹ Slovic 2000, 41.

⁵² Rasool Kenarangui, “Event-Tree Analysis by Fuzzy Probability,” *IEEE Transactions on Reliability* 40, no. 1 (April 1991): 120-124, 122.

military planners to adapt this technique is both probability and consequence are usually treated as “exact values,” while military operations usually cannot be mathematically predicted.⁵³ In addition, people tend to “average out” the probabilities, so they think that a branch that traces its inception to one very unlikely event is more likely than that event.⁵⁴ This is logically unsatisfactory, and without an actual calculation using the numbers, it is a logic trap to be avoided.

This method, accompanied as it is by a graphic and fundamentally concerned with the sequence of events over time in an operation, has certain advantages for military risk assessment within the risk management system. It supports risk perception by providing more information on how the hazards will interact with the unit and operation, rather than a simplistic risk level. By emphasizing that the risk comes from the relationship of the hazard to the plan, rather than emanating from the hazard itself at all times, it may counteract the representativeness heuristic and availability. This method may not do much to stop decision-makers from anchoring onto the risk levels for each hazard, meaning that risk decision-makers may still struggle with making gross adjustments in their perception of hazards or overall risk in relation to changing data.

Scenarios

The risk scenario is a tool used in many fields to communicate risk and illustrate the links between hazards using narrative logic. A risk scenario (hereafter “scenario”) is “a series of events linked together in narrative form.”⁵⁵ Within the context of risk assessment, a scenario is meant to aid decision-makers in understanding the underlying causes and conditions.

In their paper defining “scenario analysis,” Spaniol and Rowland identified six criteria. Scenarios are “future oriented,” provide “external context,” are “plausibly possible,” and take the

⁵³ Kenarangui 1991, 120.

⁵⁴ Slovic 2000, 44.

⁵⁵ Slovic 2000, 44.

form of a “narrative description,” they are created in a “systematized set,” are “comparatively different,” take into account the “scenario purview” especially with regard to time, and have “normative qualities” meaning it is “properly formatted as a coherent narrative.”⁵⁶ Using this definition give methodological rigor to the otherwise chaotic understanding of the category of risk scenarios.

One method of using scenarios is to construct them using In a mathematical “normative” understanding of a scenario, the probability of the “weakest link” in the narrative (the one least likely to happen) sets the “upper limit on the probability of the entire narrative.”⁵⁷ Without advanced mathematical understanding, the analyst tends to mentally “average out” the links as they determine plausibility and overall risk level.⁵⁸ For example, a scenario that contains a lot of detail and forms a compelling narrative might influence the decision-maker to be overconfident in their ability to understand hazards’ impacts or to overestimate extremely unlikely scenarios.⁵⁹

The narrative, if well-crafted, has potential to contain a large amount of context to describe uncertainty and positively impact risk perception. It inherently treats risk as a prediction of the future, which may assist the commander or decision-maker with conceptualizing how hazards impact a planned operation. Using scenarios also presents an opportunity to capture uncertainty by creating several scenarios that describe different possible futures.⁶⁰ However, there are unique drawbacks to the narrative’s impact on risk perception. The ability of the narrative to describe in detail the impact of hazards on the unit or operation cuts both ways, and the requirement on the risk management personnel or staff preparing the narrative is quite high.

⁵⁶ Matthew J. Spaniol and Nicholas J. Rowland, “Defining Scenario,” *Futures Foresight Sci* 1, e3 (2019), 7-8. <https://doi.org/10.1002/ffo2.3>.

⁵⁷ Slovic 2000, 44.

⁵⁸ Slovic 2000, 44.

⁵⁹ Slovic 2000, 44.

⁶⁰ Peter Schwartz, *The Art of the Long View: Planning for the Future in an Uncertain World*, (New York: Crown Publishing Group, 1991).

Scenarios typically do not include quantitative information, although they do include qualitative analysis and can be constructed in an orderly, systematic fashion.

A decision-maker or commander using scenarios to understand risk in an MDO environment may identify that they are in a cognitively challenging environment and need to deliberately and effortfully engage with the problem set. This is the first step to avoiding overreliance on heuristics, and made more likely due to the additional context of a scenario over a risk quadrant or fault tree.⁶¹ In this way, using scenarios may enable a skilled response rather than an automatic (and possibly misguided or inaccurate) risk perception and response.

Risk triplets

Another method of analyzing and depicting risk is a “risk triplet,” a method used by NASA in their risk management process. Using a “set of triplets” to characterize risk, each triplet contains “the scenario,” the qualitative or quantitative “likelihood...of those scenarios,” and “the consequence(s)...that would result.” Risk triplets attempt to consider uncertainties in the likelihood and consequences, acknowledging that sometimes they will be qualitative judgment calls rather than quantitative projections from data..⁶²

⁶¹ Kahneman 2011, 417.

⁶² National Aeronautics and Space Administration (NASA), *NASA Risk Management Handbook* SP-2011-3422, v.1.0 (Washington, DC: NASA Headquarters, 2011), 4.

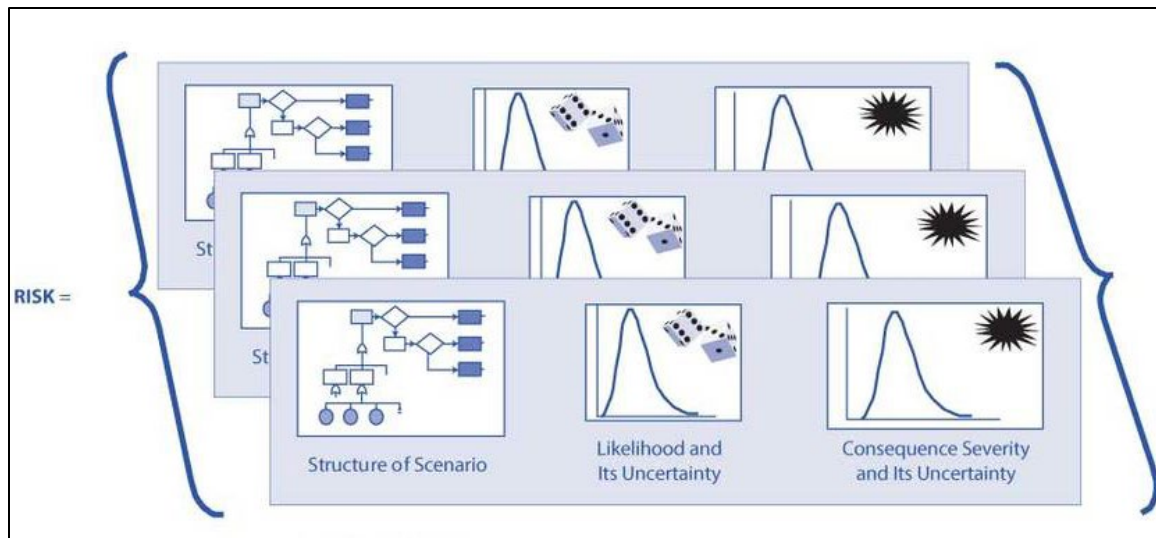


Figure 7. Risk as an Aggregate Set of Risk Triplets. National Aeronautics and Space Administration (NASA). *Systems Engineering Handbook*. Accessed 23 November 2020.

NASA risk management techniques include stakeholders in the first steps of the risk analysis. Planners find hazards by recording “stakeholders’ concerns” and then iterate those into a “risk statement” with “a condition, a departure, an asset, and a consequence” plus a “narrative description.”⁶³ By this point in the process, the risk analysis has basically generated one scenario, and continues the process to generate the “systematized set” of scenarios discussed by Spaniol and Rowland.⁶⁴

Where it is possible, the risk triplet uses quantitative information, however situations exist where there is uncertainty about exact probabilities. As the NASA risk management handbook acknowledges, “If there were no uncertainty, the question of performance assessment would be one of quantifying point value performance measures for each decision alternative. In the real world, however, uncertainty is unavoidable, and the consequences of selecting a particular decision alternative cannot be known with absolute precision.”⁶⁵

⁶³ NASA 2011, 16.

⁶⁴ Spaniol and Rowland 2019.

⁶⁵ NASA 2011, 54.

In those instances when quantitative information is unavailable, qualitative information is arranged using “a constructed scale that is qualitative in nature. For example, the technology readiness level (TRL) at the time of project initiation is a qualitative parameter because it is defined in terms of ranks that are based on non-numerical information.”⁶⁶

The benefit of a risk triplet is similar to a risk scenario, but with the deliberate inclusion of probability and consequences. It provides a narrative about a scenario instead of a single hazard. The NASA risk management process considers what type of risk analysis is called for based on the “context” of the project. Summarizing the relationship between the risk management personnel and the decision-maker, a NASA guide to risk analysis explains the objective of risk analysis and risk communication: “The goal is a robust decision, where the decision-maker is confident that the selected decision alternative is actually the best one, given the state of knowledge at the time.”⁶⁷

This method may be more time-consuming than other methods, since it is relatively elaborate, composed as it is of three interrelated products. NASA uses three priorities of risk analysis and the highest priority projects require probabilistic risk assessments (lower priority projects require a qualitative system safety analysis and “probabilistic risk assessment where appropriate”).⁶⁸ This reflects the scientific nature of their work as well as the long timelines available for risk management. The Army, especially at the operational and tactical levels of war, rarely has the time or data to conduct a true probabilistic risk assessment, except in deliberate planning and OPLAN development. Military risk management personnel will always rely on qualitative analysis, sometimes supplemented in certain functional areas with a probabilistic assessment.

⁶⁶ NASA 2011, 57.

⁶⁷ NASA 2011, 59.

⁶⁸ National Aeronautics and Space Administration, *NASA Procedural Requirements* NPR 8715.3D, tinyurl.com/26xbrd5w.

The risk triplet method presents the commander or risk decision-maker with the most amount of information and analysis, including the relationship of hazards to the operation, measured or estimated probability, and estimated consequences. This method has high potential to support a skilled response to available analysis, and therefore a subjective risk perception of the risk assessment closely fitted to the facts and organizational priorities. The commander is likely to have enough information to identify what Kahneman calls a “cognitive minefield” and then avoid the automatic, heuristic response to hazards.⁶⁹

Impact of Different Risk Analysis Tools on Risk Perception in MDO

Risk perception is essential to risk decision-making. Cognitive traps can skew risk perception and lead to poor decisions about risk acceptance, risk mitigation, and associated resource expenditure. Kahneman says the best way to avoid cognitive traps is to "recognize the signs that you are in a cognitive minefield, slow down, and ask for reinforcement from System 2."⁷⁰ This process is most effective using the “richer language” that specifically describes the cognitive traps, including the three heuristics Kahneman describes in *Judgement Under Uncertainty and Thinking, Fast and Slow*.⁷¹

Risk analysis methods that support risk perception will continue to increase in importance as the nature of warfare changes in MDO. MDO is cognitively challenging due to the anticipated conditions of warfare in the future. Expanding geographic limits to the area of operations and a contracting timeline will challenge commanders’ intuition and decision-making. One way they will be challenged is in evaluating risk to the force and to the mission in areas of responsibility much bigger than previously, impacted by enemies wielding new technology, and by a force of increased technological reliance and capable of effects across five identified domains.

⁶⁹ Kahneman 2011, 417.

⁷⁰ Kahneman 2011, 417.

⁷¹ Kahneman 2011, 418.

For MDO, the Army might benefit from including multiple risk analysis methods in doctrine and emphasizing context and narrative logic in risk communication. Risk decision-makers rely on their staffs to assist their risk perception. Risk analysis methods that obscure underlying subjective judgments, for instance by presenting a qualitative estimate as a percent probability, may reduce the ability of risk decision-makers to exercise their own critical thinking. The current risk quadrant method can be used very effectively, but it has elements that could lead to hazards being considered in isolation from the opportunities or from the actions of friendly and enemy forces that would change the risk analysis. Other risk analysis methods, particularly the risk scenario and the risk triplet (which integrates the narrative and risk quadrant method) provide context and logic, enabling critical thinking and improving risk perception.

Analysis

This does not mean that numbers are useless in real life. The trick is to develop a sense of when they are relevant and when they are not.

—Peter L. Bernstein, *Against the Gods: The Remarkable Story of Risk*

Research Question: How does risk perception affect decision-making in multi-domain operations?

Risk perception is a powerful idea for understanding how commanders react to risk assessments created or communicate by risk management personnel (usually the staff). The insights about subjective risk judgements gained from risk perception studies have implications for doctrine and the risk management process, particularly in the future OE described by Perkins and others in the MDO concept.

Doctrine calls on commanders to use their “skill, knowledge, experience, creativity, and judgment” in designing campaigns and making decisions, but the future OE is likely to challenge commanders’ ability by making previous experiences less applicable.⁷² Areas of operation (AOs) at every echelon will continue to grow in size in the land domain. Commanders at every echelon control multi-domain capabilities, rely on support from a variety of federated elements, and confront challenges across all five domains (land, sea, air, space, and cyber) as well as being intrinsically reliant on the electromagnetic spectrum. Army forces in this environment confront determined competitors, thinking and creative adversaries, and multiple neutral actors creating unforeseen and unforeseeable combinations of effects. The result is that experience and intuition have less bearing on decisions, creating what can be described (and has been described by Kahneman) as a “cognitive minefield.”⁷³

⁷² US Army, FM 3-0, 1-20.

⁷³ “Previous experience within a similar operational environment is not enough to guarantee future mission success in the current one.” US Army, ADP 3-0, 1-1. Kahneman 2011, 417.

In such a cognitive environment, it is essential that staffs and risk management personnel consider their interaction with the commander's risk decision-making process as active. Rather than presenting the commander with a risk assessment that is largely recalling past experiences and familiar hazards, the staff is likely to be analyzing strange hazards. That might include enemy cyber exploitation, constant observation by unmanned aerial vehicles or space-based platforms, and the weaponization of social media. The effects of such challenges on US forces and the speed with which US forces will have to operate to gain and maintain the initiative are new, and the reliability of old heuristics is doubtful.

Thinking of the commander's experience as essentially subjective and potentially biased by unfamiliarity, dread, or uncontrollability can help the staff to evaluate risk doctrine and other risk analysis methods. Risk perception as a phenomenon suggests that the staff must think of hazards as cognitively linked to the planned operation or the unit under consideration. With that perspective, they must also spend their mental efforts considering how well the commander and other risk decision-makers will understand the risk analysis, almost thinking of it as being convincing.

Comparing two (admittedly very different) vignettes may illustrate the changing role of risk perception in warfare. In 1942, Admiral Chester Nimitz sent a "letter of instruction" to his two subordinate rear admirals urging them to use the principle of "calculated risk" in their offensive operations before what became known as "The Battle of Midway."⁷⁴ Calculation as a principle made sense in this situation. Although it was not literally a process of quantification, the rear admirals had enough information to be confident in their assessments. They knew the exact numbers of capital ships in the Japanese and Allied fleet, as well as being informed by intelligence as to the Japanese location and intent. Even this early in the war the tactics of carrier-

⁷⁴ Robert C. Rubel, "Deconstructing Nimitz's Principle of Calculated Risk." *Naval War College Review* 68, no. 1, Article 4 (Winter 2015), <https://digital-commons.usnwc.edu/nwc-review/vol68/iss1/4>.

on-carrier battles were becoming codified, with a rule of thumb of how many air wings were required to sink a carrier.⁷⁵ “[The] numbers available to each side governed where its forces could and could not operate” and what each nation’s navy could expect to be able to accomplish.⁷⁶ At the tactical and operational level, the US commanders’ decisions were by no means easy, but the level of risk they had from engagement at any one time with available information were somewhat reasonable, and they were unlikely to encounter a surprise of epic proportions.

By contrast, the Israeli forces fighting in the 2006 Lebanon War encountered a staggering surprise when Hezbollah countered the initial offensive. Responding to a minor skirmish on the Israeli-Lebanese border in which Hezbollah militiamen ambushed a small Israeli patrol, Israeli planners expected a quick punitive incursion, thinking that based on their previous decisive victories that this would be once again easy. Hezbollah’s capabilities and resources, however, had increased substantially, and the Hezbollah defense forced the Israelis back twice before massively increased force finally waged a tactically successful but strategically embarrassing final assault around Beirut.⁷⁷

Israeli forces’ defeat and the massive surprise at the unexpected risk encountered in southern Lebanon came from a lack of understanding. As one author compellingly argued, this “fundamental surprise” arises from lack of understanding of the relationship of the self to the changing environment.⁷⁸ The overconfidence of the Israeli planners is partially attributable to their reliance on a lack of consideration of the possible risks. They failed to understand, to

⁷⁵ Rubel 2015.

⁷⁶ Rubel 2015.

⁷⁷ “Second Lebanon War: Background & Overview,” *Jewish Virtual Library*, <https://www.jewishvirtuallibrary.org/background-and-overview-second-lebanon-war>.

⁷⁸ Zvi Lanir. *Fundamental Surprises*. (Ramat Aviv: Center for Strategic Studies University of Tel Aviv, 1983), 16.

perceive, the risk due to their reductionist assessment of the risks..⁷⁹ Perhaps taking a different approach to risk assessment, informed by the idea of risk perception, will help US Army units and commanders to avoid similar disasters, and to aid their supporting staffs to execute and communicate useful, insightful analysis.

⁷⁹ Lanir 1983, 105-106.

Secondary Research Questions

Do the effects of risk perception on decision-making have implications on US doctrine?

There are two implications on Army doctrine. First, the implicit idea that if risk perception is subjective, then it is individual and more than one means of risk analysis and communication may be useful to different commanders. Second, that the terms and perspective of risk assessment may be inherently prejudicial or biasing.

Subjective means “based on or influenced by personal feelings, tastes, or opinions.”⁸⁰ Given that decision-makers experience risk as a subjective process of judgement, either instinctive and rapid or effortful and deliberate, staffs may be able to tailor risk assessment methods and resultant products to the commander’s needs. Figure 8 depicts the ways that risk analysis can emphasize different elements in support of the commander’s decision-making process. The commander may increase comprehension with a more narrative, descriptive method such as multiple scenarios or he may require a graphical depiction like the fault tree or risk triplet. The staff may need to focus on quantitative analysis for some situations or specific hazards, and rely on more qualitative methods for others, eschewing probabilistic analysis. The way that risk assessments are framed also impacts risk perception, so the staff may not focus on risk in some instances, but instead emphasize the opportunity available if a specific action is pursued in order to avoid the prejudicial nature of negative framing.

⁸⁰ *Lexico.com*, “Definition of Subjective in English,” accessed February 09, 2021, <https://www.lexico.com/en/definition/subjective>.

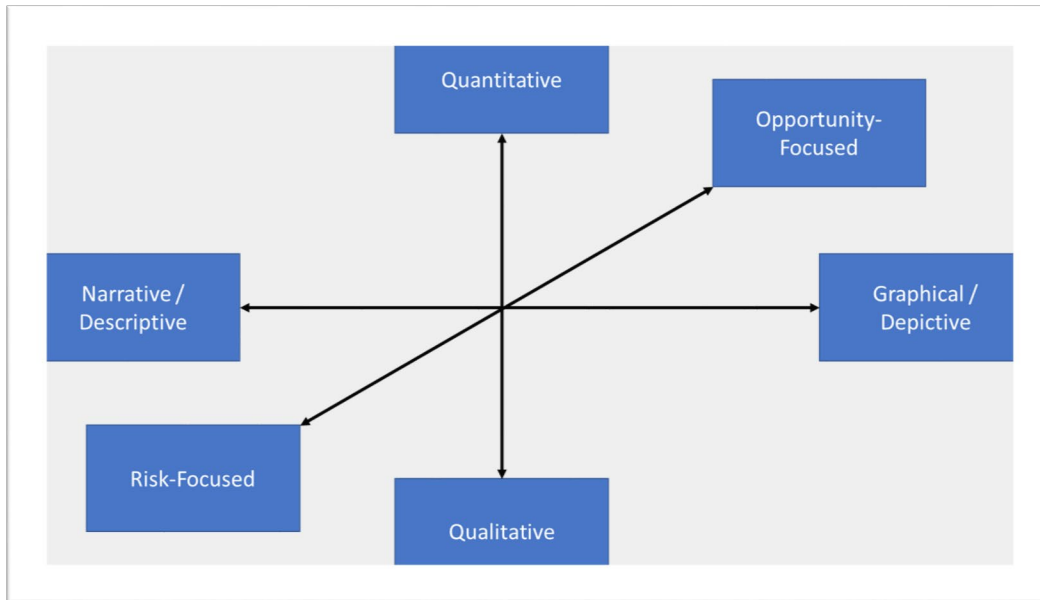


Figure 8. Categories of Risk Assessment Methods and Products. Created by author.

In general, risk perception suggests that decision-makers are not convinced by qualitative analysis, but interpret that analysis through their own values and experiences. Therefore, risk assessments that are richer in context and make explicit the links between hazards and priorities (like preservation of life, mission success, etc.) are more likely to communicate the meaning intended by risk management personnel. Many commanders have found the risk gradient to be sufficient, but the way ATP 5-19 guides staffs to conduct risk assessment may not be optimal for challenging situations.

For instance, focusing on risks rather than opportunities may encourage risk aversion at odds with the doctrinal concept that “Seizing the operational initiative usually requires accepting risk.”⁸¹ Risk perception studies show that decision-makers are influenced by an emphasis on the negative framing of a risk analysis, therefore it seems likely that OE analysis focused on the negative impacts from hazards or the potential failure of COAs could impact commander’s risk perception away from action and toward a defensive, risk-averse mentality. Rarely is the

⁸¹ US Army, ADP 3-0, 1-11.

commander's role in combat or support operations to avoid hazards; on the contrary it is to accept risk to the force and even risk to the mission to seize opportunities in the operational environment or in relation to the enemy. Risk perception suggests that rather than focuses on risk and how that risk threatens the force, the supporting staff might need to focus on opportunities and how the force can create windows of opportunity through a given COA.

Do any historical examples provide insight into the challenge of risk perception when encountering unfamiliar problems?

The short vignettes from 1942 and 2006 illustrate a potential trend of challenges to risk perception. In general, military operations have increased in speed and commanders are able to affect a larger area of operations. Technological innovations continue to speed up, in physical domains, cyber operations, and information operations. Only after failed initial operations did the Israeli military decision-makers recognize the “cognitive minefield” they had wandered into, and their misplaced reliance on experiences in a similar environment.⁸² It is difficult (and perhaps hubristic) to imagine that any researcher in 2021 could say that using a specific method of risk assessment would have prevented such fundamental surprise, but it is logical to look for ways to avoid the same cognitive trap in the future. Future case study analysis of risk perception in war should evaluate this campaign as an example of risk perception when encountering an unfamiliar problem.

Can models from psychology and science enable understanding of risk perception in military decision-making?

A model of risk perception not fully explored in this research is the idea of psychometric paradigms. By identifying and quantifying psychological components of risk perception, Paul Slovic revealed reasons for risk perception underpinning conscious decision-making. Future

⁸² “English Summary of the Winograd Commission Report.” *New York Times*, January 30, 2008, <https://www.nytimes.com/2008/01/30/world/middleeast/31winograd-web.html>.

research or other efforts to apply risk perception to military decision making should study the psychometric paradigm with regard to commanders and risk management personnel to understand the components and what the implications are for units.

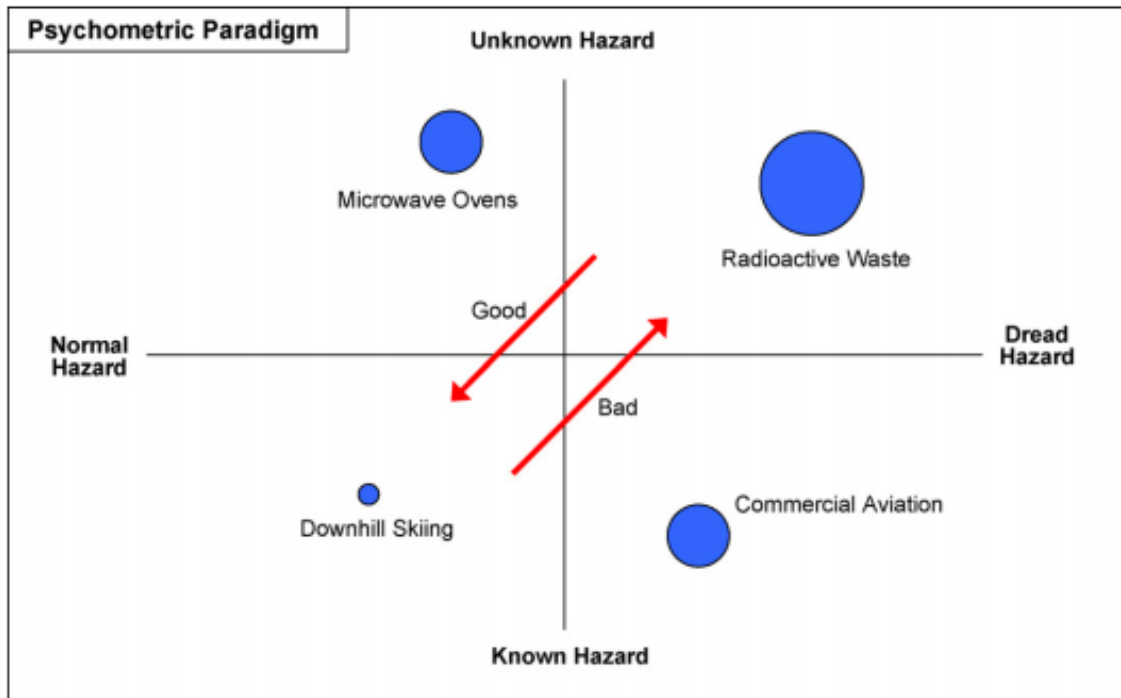


Figure 9. Depiction of Psychometric Paradigm. Gregory Singleton, Stephen Herzog, and Stephen Ansolabehere. "Public Risk Perceptions on the Geologic Storage of Carbon Dioxide," *International Journal of Greenhouse Gas Control* (2008), doi: 10.1016/j.ijggc.2008.07.006. https://sequestration.mit.edu/pdf/IJGGC_Singleton_Herzog_Ansolabehere.pdf.

Should US Army leader development change to improve risk perception in multi-domain operations?

The Army should continue to emphasize critical thinking and evaluate the knowledge, skills, and abilities (KSAs) of leaders in anticipated future environments. Critical thinking is currently part of the Command and General Staff School (CGSS), School of Advanced Military Studies (SAMS), and School of Command Preparation (SCP) curriculum in Fort Leavenworth, Kansas and the Army War College in Carlyle, Pennsylvania. With the recent closure of the TRADOC Red Team course, one course and training resource for critical thinking has recently disappeared. An emphasis on integrating critical thinking throughout the skill-specific training in those institutions could improve the ability to understand an environment and make decisions in

the officer corps. Dr. Stephen Gerras of the Department of Command, Leadership, and Management at the Army War College has written and spoken about the importance of a critical thinking focus in that institution.⁸³ Given an understanding of critical thinking as a trainable skill, this likely is the single most effective way to improve risk perception by commanders and staff officers.

The Army Research Institute is actively engaged in evaluating KSAs to inform the force of required traits and behaviors. The Army's recent changes to the personnel system, including merit-based promotion sequences for company-grade officers and rigorous assessment boards for accession to the command selection list (CSL) provide excellent venues for testing and evaluating those KSAs. Professional military education (PME), training, and mentorship prior to those advancement gates should focus on developing staff members capable of generating thoughtful, skilled risk analysis as well as leaders that can exert good judgement of risk in cognitively challenging environments.

⁸³ Stephen Gerras, "Thinking Critically About Critical Thinking," 2008.
<http://www.fededtv.com/tvwimages/fedexec/Thinking%20Critically%20About%20Critical%20Thinking%20Col%20Gerras.pdf>.

Conclusion

Commanders accept risks to create and maintain conditions necessary to seize, retain, and exploit the initiative.

Seizing the operational initiative usually requires accepting risk.

ADP 3-0 Operations

The Army's doctrinal risk assessment process presents a snapshot of hazards to the risk decision-maker or commander, without explicitly considering the subjective process of risk perception. The commander's role is to accept risk when it creates opportunities, and avoid or mitigate risk when able. A risk assessment or risk analysis that does not help the commander cognitively link risk to possible opportunities will probably cause the commander to perceive the hazards in a different way than a method that describes the relationship of hazards to the planned operation, acknowledges the uncertainty in qualitative risk assessments, and avoids misleading or confusing probabilities.

The challenge of risk decision-making is almost certain to increase in future warfare, given the tendency for ground combat operations to become faster, more complex, more technologically dependent, and to encompass larger areas of operations across all five domains. Commanders use their experience and intuition, intuition being rapid almost instinctive decision-making based on experience. Intuition is best honed in contests or environments of a repetitive, rule-based nature. As our competitors and adversaries challenge traditional norms and combine emergent tactics, techniques, and procedures (TTPs) in innovative ways, they will also challenge the ability of commanders to rely on intuition gained from previous combat and training experiences. Commanders will have to recognize the "cognitive minefields" of these unforeseen challenges and transition from the instinctive, intuitive "System 1" type of thinking to a deliberate

“System 2” thinking, engaging in critical thinking and avoiding overreliance on cognitive shortcuts, or heuristics..⁸⁴

In light of these challenges to decision-making, and the necessity of identifying cognitively challenging risk situations made urgent by rapidly increasing complexity of MDO, the Army should consider alternative risk analysis methods. Any other methods should support risk perception and help the commander to respond with a “skilled” rather than reflexive risk decision. Staffs and risk management personnel should be creative in using alternative risk analysis methods, and consider which methods are most appropriate to the situation, best support the commander’s risk management, and which methods generate products or information that will help the entire formation and subordinate commanders understand acceptable risk levels.

Fault trees (or event trees) explicitly link hazards to an expected sequence of events, and creates a graphical depiction of the identified hazards. The possible drawbacks of this method are that it may not capture all hazards, or may list many, many hazards, becoming too busy to be easily understood. Mathematical methods exist for computing probabilities, or the risk management personnel preparing a fault tree can use the same sort of estimation as ATP 5-19 requires.

Scenarios are sometimes not used in a risk planning process because scenarios are not quantitative, and including numerical statements of probability is considered the mark of rigor. In a risk quadrant, however, the “bins” of probability such as “frequent,” “likely,” or “occasional” are already estimates, only rarely based on actual statistical analysis..⁸⁵ The potential benefit of using a narrative scenario is that it can link the hazards to the planned operation or the unit’s capabilities with rich context. Using more than one scenario can describe multiple futures, acknowledging the uncertainty of a military operation which may be affected by weather, allies,

⁸⁴ Kahneman 2011.

⁸⁵ US Army, ATP 5-19, 1-18.

and a thinking enemy. Staffs preparing a scenario analysis should be aware of the risk of a compelling narrative to impact risk perception by personalizing hazards or convincing audiences without sufficient analysis.

Risk triplets combine event trees or narratives plus the quantitative and qualitative aspects of a risk gradient. Presenting three products as the output of the risk analysis process, the “structure of the scenario,” probability, and consequence, the risk triplet has potential to support the commander’s subjective risk perception by explaining how hazards could arise, their relationship to the planned operation, and the specific qualitative and quantitative analysis of individual hazards.⁸⁶ The commander, thus armed, can decide if this requires a skilled or instinctive risk decision, since he will have better awareness of whether a situation represents a “cognitive minefield” of unfamiliar, unique, or misleading elements.

The Army’s understanding of the role of risk in operational planning has changed significantly since the 1980s, when it was mentioned only briefly and in passing in doctrine. Incorporating an understanding of risk as a subjective experience on the part of the commander (and to a lesser extent, the staff and risk management personnel), rather than as a static formula presented without cognitive links to the OE and planned operation could help units and commanders make skilled decisions in the challenging future OE. There are three ways the Army can incorporate risk perception concepts and improve the risk management processes – by focusing on leader development, professional military education, and risk doctrine.

The implication to leader development is two-fold, in building the ability of leaders and in selecting leaders for key roles. Given the emphasis the Army places on risk analysis, officers, NCOs, and enlisted personnel that are involved in the risk management process should be trained to identify and overcome biases and to frame problems in ways that support skilled decision-

⁸⁶ National Aeronautics and Space Administration (NASA). *Systems Engineering Handbook*. Accessed 23 November 2020. <https://www.nasa.gov/seh/6-4-technical-risk-management>.

making. Both training exercises and professional development programs could be useful venues for these for this training. Historical case studies of leaders that grappled with very unfamiliar OEs, whether they did it well or failed, might illustrate both the significance of the challenge and ways to think about similar problems. Exposure to cognitive theory, such as Daniel Kahneman's heuristics and biases, Paul Slovic's risk perception, or Ellen Peter's studies on numeracy could also help leaders avoid common pitfalls in qualitative analysis and risk communication.

In selecting leaders for command or other key roles, the Army should consider which knowledge, skills, and attributes (KSAs) risk perception studies require, and the challenges of risk analysis in the future OE pose. The U.S. Army Research Institute already studies KSAs for specific roles (such as information operations officer) or cognitive tasks (such as using Army Design Methodology).⁸⁷ Some existing KSAs may be linked to better risk perception, such as "ability to acknowledge and accept complexity" or "Skill in identifying and accessing relevant expertise," but it would require further study to make that determination with scientifically sound data and use it in formal settings like command selection assessments.⁸⁸ Regardless, the concept and of risk perception may provide useful insights into required KSAs for units engaged in talent management through the Assignment Interactive Module (AIM) or other means.

Professional military education (PME) provides an opportunity to develop and assess the abilities of officer and NCOs to make skilled decisions and perceive risk in complex, unfamiliar situations. Critical thinking, already a small part of officer PME, should be emphasized. Tools like meta-questioning, scenario thinking, and design all offer useful critical thinking tools to support risk management. Unfortunately, with the closure of the TRADOC Red Team course, a valuable resource for training critical thinking has disappeared from the Army's arsenal. To

⁸⁷ Heather M.K. Wolters, "Technical Report 1339: Identification of Knowledge, Skills, and Abilities for Army Design," U.S Army Research Institute for the Behavioral and Social Sciences (April 2014).

⁸⁸ Wolters, A-1 to A-4.

compensate, and build the ability of the officer corps and operational units to conduct MDO, the Army must continue to focus on critical thinking as an ability that can and must be improved throughout career-long PME, starting with basic officer and NCO courses, and progressing from there.

Improvements to the risk management process may also require changes to Army risk doctrine. While the standardized risk quadrant may be required for some administrative requirements, Army doctrine should encourage creativity and critical thinking in the risk management process, rather than rote use of a matrix. DA 385-30 already suggests using additional tools to discriminate between hazards with identical results on the risk matrix.⁸⁹ That flexibility to employ other types of analysis and examples of the methods, for instance those examined in this monograph, may be useful in situations where complexity or unfamiliarity challenge the use of a simplistic rubric such as the risk matrix or risk quadrant. This change would also bring Army risk doctrine more in alignment with available cognitive science.

An update in how the Army thinks about is required to support commanders as they make the most important decision about risk: where to take risks in order to gain the initiative and accomplish the objective. The risk to the Army from emphasizing risk as an element of operational art and a key part of any planning is not just that commanders make poor decisions on how to mitigate hazards, it is the loss of life, failure to achieve tactical success, and the subsequent inability to achieve desired operational and strategic outcomes.

Future MDO with near-peer or peer competitors will require US Army leaders to take risks, but challenge their ability to easily judge the risk level of specific operations operational approaches. Given the future intense cognitive demands on military risk decision-makers, the Army should make doctrine and leader development reflect what scientists know about risk perception. This includes the individuality of risk decision-makers and the importance of context

⁸⁹ US Army, DA 385-30, 8.

and framing. Using new risk analysis methods from other fields, emphasizing critical thinking, and updating doctrine will make staffs more effective in supporting their commanders and the subordinate units in an organization as they shape and dominate future conflicts.

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