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Beyond the Risk Matrix: Ethnographic Insights into Perceived Control of NATO's Risk Management

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NATO conducts operational planning in an extraordinarily complex, multidimensional environment, and its prescribed tool for communicating risk is the two-dimensional risk matrix. This paper, part of the NATO Risk Propensity Project, critically examines whether such matrices provide meaningful analytical value to NATO headquarters' planning and decision-making. Drawing on contemporary risk science and cognitive psychology, the study combines over 800 hours of non-participant ethnographic observation, 27 interviews with staff officers and senior commanders, and document analysis of doctrine, directives, standard operating procedures and templates. A bespoke ten-step analytical protocol is applied to matrices and their underlying "risk cards" to assess surface presentation, underlying logic, and operational coherence. The findings show that risk matrices compress deep uncertainty into visually tidy categories, misuse ordinal scales, distort probability, and obscure differences in knowledge strength, mitigation cost, and consequence dynamics. In practice, they function more as symbolic compliance artefacts than as uncertainty-literate analytical tools, and may reinforce cognitive biases and pseudo-certainty. The study does not support the hypothesis that risk matrices add meaningful analytical value to NATO's planning and decision-making. Instead, it concludes that continued reliance on traditional risk matrices is neither scientifically defensible nor professionally justifiable.

Keywords: Risk Assessment, Risk Matrix, Decision-Making, Cognitive Bias, NATO.

1. Introduction

A 'holistic view of the operational environment', as depicted in the United States military doctrine adopted by the North Atlantic Treaty Organization (NATO), portrays the context of military operations as comprising five physical domains, three informational dimensions, six systems, three categories of actors, and more (Joint Chiefs of Staff 2020; Donnelly and Farley 2019). NATO's method for developing and communicating a military plan to affect this environment normally contains several parallel lines of operations, a myriad of operational actions to be taken to create a wide range of operational effects designed to establish a series of decisive conditions enabling the achievement of a desired future state (NATO 2019b, 2021, 2022). In this environment, NATO's prescribed tool for communicating risk, remains the two-dimensional risk matrix which reduces this intricate, multidimensional reality to a simplistic grid (NATO 2019b, 2019a, 2020, 2023). This reduction potentially obscures the true complexity of operational risk with the risk Matrix being the tip of an "iceberg". The matrix only reveals a limited fraction of the whole risk structure with the larger foundation lying hidden. The critical question for NATO is whether its analysis has adequately accounted for this submerged portion or is NATO drawing operational conclusions based on a limited perception of the whole?

This paper forms part of the NATO Supreme Allied Commander Transformation endorsed doctorate program's, NATO Risk Propensity Project, which seeks to determine whether contemporary risk science can enhance NATO's planning and decision-making practices. The specific contribution of this paper is a critical examination of how risk matrices are used in NATO headquarters during planning and decision-making. Drawing on the empirical data produced in this research project, the paper tests the hypothesis that NATO's use of risk matrices provides meaningful analytical value to these processes. As a tool for risk assessment and communication, the risk matrix has been subjected to considerable academic scrutiny, as discussed in the theoretical framework. The

subsequent sections outline the study's methodology, present and analyze the findings, and conclude with key implications for practice.

2. Theoretical Foundation

As stated in this paper's introduction the risk matrices grossly simplify reality with their two-dimensional design. This can often result in risk events with important differences being depicted as virtually identical. This issue, which is serious enough on its own, gets exacerbated by the ambiguity of input to and uncertainty of interpretation of the matrix by decision-makers (Cox 2008). For example, related to risk listed at maximal severity coupled with minimal likelihood, or the inverse, the matrix can be 'worse than useless' (Cox 2008, 500). Disparities in how resource intensive mitigation of different risks events are not included in the matrix designs (Cox 2008). Furthermore, risk matrices do not provide an indication of the strength or weakness of the knowledge underpinning the risks plotted in the matrix or their envisioned mitigations, (Aven and Thekdi 2022). A crucial piece of information for the judgment of two identically placed risks events with great disparity in foundational knowledge. When using 'mathematical' scoring, use of numerical scales, and color-coded areas of the matrices, they present an impression of credibility that is unjustifiable and can lead to pseudo-certainty the likes of cognitive biases (Cox 2008; Aven and Thekdi 2022; Tversky and Kahneman 1974). Additionally, risk matrices cannot depict the dynamic and complex nature of consequence variance because it is built on a narrow and misleading understanding of the overall risk concept. By focusing on intuitively appealing simple measurements the risk matrices are omitting the perpetual presence of uncertainty (Aven 2023; Aven and Thekdi 2022; Tversky and Kahneman 1974). This paper accepts the conceptual definition of risk as 'the consequences of the activity and associated uncertainty' (Aven et al. 2018, 4; Aven and Thekdi 2022, 11), while NATO Doctrine subscribes to risk being '[t]he effect this uncertainty has on [achieving] their objectives' (NATO 2019a, D-1). More broadly, risk assessments are often presented with the impression of objectivity whilst masking the underlying value laden, subjectivity of choices, arbitrary assumptions and large uncertainties associated with the assessment (Aven 2011). A point that further undermines the credibility of risk matrices.

Building on the heuristics-and-biases framework developed by Tversky and Kahneman (Gilovich and Griffin 2002), which explains human decision-making under uncertainty, several researchers have demonstrated the cognitive difficulties of sober risk assessment and judgment of risk as part of decision-making (Slovic 2010, 2000; Kahneman, Sibony, and Sunstein 2021; Kahneman 2011). Heuristics in the form of cognitive shortcuts can lead to systemically distorted judgements with cognitive bias, due to the subconscious tendency to avoid strenuous cognitive processes as a result of the mind's preference for cognitive ease (Kahneman 2011). Which is a generic human propensity. The obviously strenuous work required to thoroughly assess and understand the complexity, size and inner mechanics of the "iceberg" that is the operational environment NATO are expected to operate in has the hallmarks required to prompt heuristics and lead to cognitive biases. With uncertainty as a cornerstone of the conceptual definition of risk, and decision-making under uncertainty being the starting point for the development of the canonical heuristics-and-biases framework (Aven and Thekdi 2022; Tversky and Kahneman 2018a), the persistent use of simplified tools such as risk matrices must therefore be viewed through the lens of human cognitive tendencies to reduce complexity and seek cognitive ease, even at the expense of analytical accuracy. For brevity and the focus of this paper only a select few potential cognitive biases will be addressed.

Firstly, for any factor to influence judgment it must be both known and retrievable when needed. Thus, the availability heuristic, implies that information which is more easily recalled tends to be given disproportionate weight, irrespective of its true relevance (Tversky and Kahneman 1974). Salient or initial information may further act as an anchor, constraining subsequent reasoning. Because judgment is also sensitive to how information is framed, equivalent data presented as gains or losses can evoke different evaluations (Kasperson et al. 2022; Tversky and Kahneman 2018b; Slovic, Fischhoff, and Lichtenstein 2000). Moreover, emotional reactions can activate the

affect heuristic, leading individuals to evaluate risks and benefits through their feelings rather than analysis (Slovic and Peters 2006; Finucane et al. 2000)). These processes, together with confirmation bias and overconfidence (Nickerson 1998; Fischhoff, Slovic, and Lichtenstein 1977) can distort assessment and reinforce pre-existing preferences. Within hierarchical organizations such as NATO headquarters, additional influences like authority bias and deference to rank may further amplify these cognitive distortions (Milgram 1963; Ramos 2019).

3. Methods of Research

This study was conducted by an insider researcher embedded in NATO headquarters as part of a NATO-endorsed Professional Doctorate program. This position enabled privileged ethnographic access to classified and unclassified planning processes, internal documentation, and risk-related practices. The research was guided by both critical risk scholarship and participant-observation methodologies, and subject to strict ethical and security constraints (Sjøgren et al. 2024). All figures used in this paper are drawn from unclassified documents or are fictionalized illustrations designed to accurately represent typical classified content without disclosing sensitive information.

3.1 *Data Collection*

The study draws over 800 hours of non-participant ethnographic observation in NATO operational planning and decision-making as well as 27 semi-structured interviews with NATO staff officers and senior decision-makers across multiple multinational headquarters (Table 1). This was supported by analysis of a curated document corpus consisting of doctrine, directives, standards operating procedures for individual headquarters, handbooks, operational plans, orders, annexes, briefings, and risk-related templates. These documents were collated from both classified and unclassified contexts. These sources were analysed to explore the practical application of risk matrix usage in NATO headquarters, with attention to both formal doctrine and informal interpretation.

Table 1 – List of & Interviewees
(Solli and Borrie 2025b, 2025c, 2025d)

Codename	Rank
Ten of Spades (10S)	NATO Civilian
Jack of Clubs (JC)	NATO Civilian
King of Diamonds (KD)	NATO Civilian
Five of Hearts (5H)	Major
Eight of Clubs (8C)	Major
Ten of Diamonds (10D)	Major
Four of Clubs (4C)	Lieutenant Colonel
Six of Diamonds (6D)	Lieutenant Colonel
Eight of Spades (8S)	Lieutenant Colonel
Nine of Clubs (9C)	Lieutenant Colonel
Ace of Spades (AS)	Lieutenant Colonel
King of Clubs (KC)	Lieutenant Colonel
Queen of Hearts (QH)	Lieutenant Colonel
Five of Clubs (5C)	Colonel
Seven of Clubs (7C)	Colonel
King of Spades (KS)	Colonel
Queen of Diamonds (QD)	Brigadier General
Three of Clubs (3C)	Major General
Three of Spades (3S)	Major General
Nine of Spades (9S)	Major General
Jack of Spades (JS)	Major General
Ace of Clubs (AC)	Major General
Seven of Hearts (7H)	Lieutenant General
Jack of Hearts (JH)	Lieutenant General
King of Hearts (KH)	Lieutenant General
Ace of Hearts (AH)	Lieutenant General
Eight of Diamonds (8D)	General

3.2 *Analytical approach*

In order to critically examine the structure, usage, and communicative reliability of risk matrices, a ten-step analytical protocol was developed (Table 2). The method is divided into three layers of analysis: Surface-Level Analysis (Steps 1 – 3): Evaluates the visible, presented elements of the risk matrix, the aspects readily accessible to decision-makers. Sub-surface-Level Analysis (Steps 4 – 8): Examines the underlying Risk Assessment Templates and the internal risk logic not directly visible in the matrix, but essential for assessing its analytical integrity. Deep Dive level (Steps 9 – 10): Evaluates overall adherence to operational logic and methodological rigor. This approach reflects the central metaphor introduced earlier: that risk matrices are “iceberg-like” representations. Visually neat but never fully representing the complex, submerged foundation of operational risk. This analytical framework was applied iteratively across collected documents and field examples to test the internal

consistency and communicative transparency of risk matrices as used in NATO headquarters.

Table 2 – Risk Matrix Ten-Step Analytical Protocol

Steps	Areas to Critically Review
1 - 3	Surface level: Risk Matrix Check that risk titles are clear (1), matrix placement of likelihood–severity is coherent (2), and residual risks are visibly distinct and consistent (3)
4 - 9	Sub-surface level: Risk Cards Confirm that matrix content aligns with risk card narratives (4), risk descriptions reflect actual conditions (5), scoring and sources are credible (6), and proposed and post-treatment changes are feasible (7), justified, and explicit about which dimension (likelihood or severity) is affected (8).
9 - 10	Deep Dive level: Contextual Validation Ensure that treatments link to specific operational actions or responsibilities (9) and that the matrix faithfully represents the underlying logic and evolution of risk before and after mitigation (10).

The qualitative date analysis of this research project's data was initially subject to deductive codes, and subsequently inductively developed codes through an iterative process.

4. Findings

The preceding work of this research project have addressed the use of risk matrices in various ways. For the sake of completeness of this paper, the following presentation of findings will also include previously addressed findings. Due to the need for brevity and adherence to security classifications this paper's Figure 1 is a fictitious amalgamation of the different risk matrices observed and is used to depict key findings. It also illustrates the use of 'risk cards' to analyse each 'risk' prior to it being plotted in the matrix.

4.1 *General Risk Management*

An important overarching finding is that NATO has a tacit risk management practice that permeates most if not all of the headquarters' activities. The use of risk matrices however, is only a part of the formalized risk management activities. Relevant for this paper is the extensive degree of risk deliberation and command level framing conducted by the senior leaders in formal settings with breadth and depths of headquarters participation without explicit connections to risk management (Solli and Borrie 2025c). Furthermore, it can be argued that virtually all activities and sub-processes as part of NATO's Planning and Decision-Making processes contribute to headquarters risk management (Solli and Borrie 2025b, 2025c).

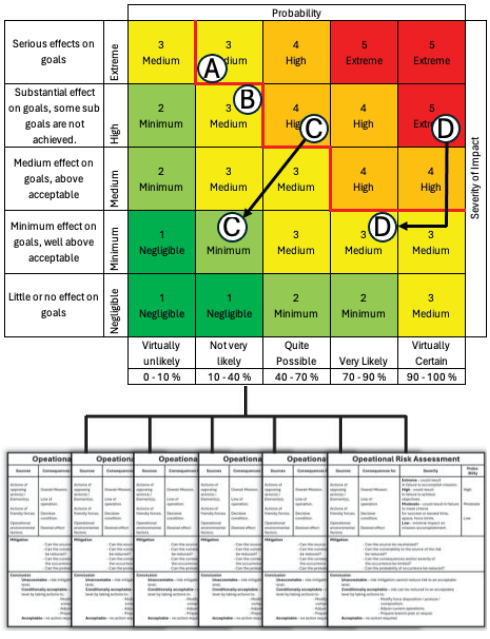

Figure 1 – NATO Risk Matrix Amalgamation

4.2 *Underpinning Document Analysis*

Previous research revealed multiple risk matrices prescribed in NATO's authoritative documents. These differences in prescribed matrices obstructed interoperability of risk communication by decreasing the ability to share risk assessments between headquarters (Solli and Borrie 2025a). There is mismatch between risk assessment templates, often referred to as 'Risk Cards', and the risk matrices. Like Figure 1, both the doctrine for conducting operations and the Strategic Management System Directive risk matrices are symmetric with two-axis containing five levels of value for each (NATO 2019a, 2020). In contrast, the risk card template in NATO's doctrine and planning directive use four levels for severity of consequences (Extreme, High, Moderate & Low) and three for probability (High, Moderate & Low) (NATO 2021, 2019b). This issue is easily observed if applying rigor such as step two or six

of the ten-step protocol. Furthermore, the practitioners are compelled by doctrine to include a risk tolerance line decided by the commander that separates the part of the risk matrix where risk will be deemed unacceptable and the parts of the risk matrix where risk can be assessed to be acceptable. (as illustrated by the thicker red line in Figure 1) (NATO 2019a, 2019b). Yet, at least one NATO risk management document warns against the use of a commander's risk tolerance line (NATO 2023; Solli and Borrie 2025a). Related to the design of risk matrices the NATO (2020) directive defines a five-level quantitative scale for likelihood, with intervals expressed as percentages: 0–10%, 10–40%, 40–70%, 70–90%, and 90–100%. Despite differences in the size of each interval, they were all visually presented as being of equal size as shown in Figure 2. This problem was identified as early as Step 2 (surface level analysis) of the ten-step protocol.

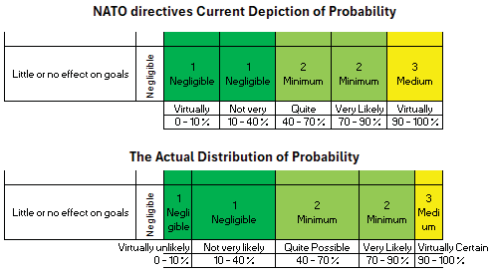

Figure 2 – Misleading Probability Distribution

4.3 *Observations*

First, while most NATO headquarters were observed using Risk Matrices several different versions were used. A color-coded 5x5 matrix based on a NATO directive template was most commonly used but with variation. The majority used matrices combining two types of measurements: qualitative assessments of severity and quantitative assessments of probability. However, this was not universal practice. One headquarters extended their matrix to include assessment of 'opportunity' as a counter-point to the matrix for negative potential consequences. Directive templates were 'interpreted' by each individual headquarters. Variations in practice was particularly apparent when observing the presentation of risk matrices and 'risk cards' to commanders. Application of the ten-step protocol to 'risk cards' highlighted issues with consistency of information delivery. 'Risks' presented to commanders was in essence envisioned potential adverse consequences (PAC) of planned or ongoing military operations. Each PAC was assigned a current value (risk) and an anticipated value post mitigation (residual risk) (illustrated by risk C and D in Figure 1). Whilst observed risk presentations were all based on the prescribed templates in NATO doctrine and planning directive there was variation in both form and content. A series of problems emerged during observation: The risk mitigations presented were often vague and imprecise in their formulation. Only by exception were mitigations presented as clearly actionable tasks assigned to specific parts of the force. Proposed mitigations were consistently at variance with what was illustrated in the risk matrix. A pattern emerged of post mitigation PACs being plotted in the matrix on the acceptable side of the commander's risk tolerance despite the data on the 'risk card' not justifying this. In essence, PACs were underestimated to fit with a commanders perceived risk tolerance. The connection between pre and post mitigation was illustrated with arrows as illustrated in Figure 1 for C & D. Most visualized mitigations effects moved the risk on both axis, despite not distinguishing between treatment measures addressing probability or severity on the 'risk cards'.

Observed practices suggest that staff officers did not assess risk with the analytical rigor of the deeper levels of the ten-step protocol. Subsequent discussion of PACs by senior leaders and their closest advisors took place without understanding of the foundational analyses underpinning the risk presented such as the 'risk cards'. These discussions were constrained by the framing of risk as probability multiplied with impact presented in the risk matrices. Consequently, command group discussions were not able to discuss risk beyond the surface level of the ten-step protocol and certainly not with the analytical rigor of the deeper levels.

4.4 *Interviews*

Lack of understanding and formal training to enable NATO staff to fully assess and manage risk was linked to the quality of input in risk analysis during several interviews (8S, 9C, JC & QH). According to AH, a three-star general, 'the current focus on risk is a generational thing', and

not thought as a topic when AH was a younger officer. At the same time understanding risk when briefed in decision-briefs is considered to be of paramount importance by 9S. Concurrently, several interviewees highlighted that responsibility for risk lies fundamentally with the commander (8S, AC, AH, AS, JS). Both 3C and 7C expressed concern of the bureaucratic process from risk identification until it is presented for decision. Fearing dilution or distortion of the risk picture due to a variety of potential factors. Several expressed concern of risk management being reduces to a something superficial as a PowerPoint slide or a simple check list procedure. (5H, 6D, JC, JH, QD, HQ). 3C observed that general officers rarely have time to engage with the underlying foundations of the risk presentations they receive. This view was partly contested by 3S, who expressed a clear preference for personally reviewing the underlying risk data. This general also cautioned that risk matrices can become overly complex and stated a preference for limiting color coding to three colors. 7H, another three-star general, forcefully conveyed the belief that risk mitigation always comes at a cost. This view was broadly reiterated across several other interviews, which emphasized that effective risk mitigation requires deliberate prioritization and acceptance of tradeoffs (3C, 8D, 9C, 10S, JS, KH, AC, AH). An appetite for a more comprehensive tool to assess the risk picture of a military operation was demonstrated when a limited set over interviewees was presented with a prototype alternative to the risk matrices (3C, 5C, 7H, 9S, 10D, KS). Despite this positive attitude, it was stated that any depiction of risk will be a simplification of reality, enable cognitive biases in its application and may be manipulated by staff to justify their preferred decisions (7C, 9C, JC, JH, KS).

5. Discussion

The findings illustrate that risk matrices, despite their widespread doctrinal presence, frequently operate more as visual symbols of compliance than as analytical instruments capable of supporting uncertainty-literate decision-making. NATO's application of these tools consistently privileges surface-level coherence over the rigorous interrogation of underlying assumptions. Risk matrices presents the above surface parts of the "iceberg", its evolving and unforgiving complexity often remains submerged and insufficiently explored. This gap was made evident through the systematic application of the ten-step protocol developed in this study. Risk matrices did mostly meet the expectations at surface level, such as consistent formatting and clarity with one two serious exceptions. The most common risk matrix template distorts the visual representation of probability, which effectively destroys the proportional relationship between probability intervals. As demonstrated in Figure 2, this distortion invalidates any inference or conclusions drawn from the matrix. Viewers naturally assume that equal physical representation corresponds to equal probability distributions, leading to systemic misrepresentation. The risk matrix template, by design foster such cognitive biases and thereby undermine the reliability of risk assessments. Furthermore, as illustrated by Figure 1 probability is shown using percentage ranges, while severity relies on ambiguous qualitative categories. Yet both operate as ordinal scales, creating a structural incompatibility when they are combined in a risk matrix. However, this is apparently not appreciated by the practitioners or decision-makers in NATO.

Sub-surface and deep-dive review of the risk matrixes and risk cards revealed significant weaknesses. Discrepancies between matrix content and the associated risk cards were common. Risk treatments were frequently vague, lacking attribution, and rarely distinguished between intended effects on probability or severity. Despite being plotted as mitigated to acceptable zones, many of the post-treatment values lacked justification when judged against the protocol's steps. This pattern suggests that mitigation shown in matrices were often speculative, if not a result of heuristics leading to anchoring, authority and confirmation biases. Giving reason to assume that the matrices can serve as a catalyst for cognitive biases and pseudo-certainty. A serious accusation given the importance placed on mitigation form the interviewees. This is also technically problematic as pointed out by Cox (2008) since the matrices do not offer a way to express differences in the cost of the envisioned mitigation. Moreover, the risk tolerance lines imposed by doctrine further constrained critical engagement. Rather than encouraging nuanced assessment, they anchor risk framing to static thresholds, directing attention away from the underlying quality of knowledge or feasibility of action. This structural bias is evident

in Figure 1: point A, B and the post-mitigation D all receive the same numerical risk score (12) if the two axis was replaced with 1 – 10 scales, despite potentially significant differences not possible to include in the risk matrix. Such as temporal aspects strength of knowledge and urgency. These differences cannot be expressed within the matrix format, highlighting the loss of information and the misuse of ordinal scales inherent in such scoring. Observed staff practices reflected a narrow use of the matrix as a plotting exercise, disconnected from operational consequence chains. The "iceberg" analogy again proves useful, as senior leaders engaged primarily with the visible structure, rarely questioning the submerged layers that give the risk depiction its integrity. Further strengthening the reasonability of assuming vulnerability to cognitive biases being exacerbated by the matrices. The interviews reinforced these observations. Officers acknowledged that their understanding of risk tools was often limited, shaped more by inherited bureaucratic habits than formal training. Several noted the tendency for risk management to become a procedural formality, reduced to briefing slides rather than integrated into planning logic. In such contexts, the matrix becomes a cognitive shortcut, enabling presentations of control while muting complexity. Senior leaders expressed both concern and appetite for alternatives, this highlights the institutional ambivalence surrounding current practices.

6. Conclusion

When reviewing NATO's use of risk matrices through the combined lens of contemporary risk science and psychological theories several critical limitations are revealed. Similarly, the possibility of such limitations like cognitive biases affecting the analysis of this paper may not be excluded. The complexity found in the environment NATO may conduct military operations, and the technical complexity of military plans in of itself makes the legitimacy of risk matrices questionable. The technical flaws documented in the literature, combined with the practical shortcomings observed in this research, indicate that matrix-based approaches compress profound uncertainty into artificially tidy categories. Rather than enhancing judgement, they can create an illusion of analytical precision and control. The study therefore does not support the hypothesis that risk matrices provide meaningful analytical value to NATO's planning and decision-making processes. On the contrary, the empirical data and established risk science suggest that continued reliance on traditional risk matrices is neither scientifically defensible nor professionally justifiable.

Therefore, further research into alternatives to risk matrices should be prioritized. However, one alternative can be found in our (2025d) paper 'Risk Trajectory Theory – Temporally Conceptualizing Risk to Aid Decision-Making Processes'

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