SCANDINAVIAN JOURNAL OF MILITARY STUDIES

# Developing Strategic Mindsets with Matrix Games

COLLECTION:
WAR GAMING

RESEARCH ARTICLE

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SCANDINAVIAN MILITARY STUDIES

## ABSTRACT

This article forms part of the Norwegian Defence University College's broader research and development project to explore the utilities and potential of a wide range of wargames and military exercises in professional military education. We present a specific matrix game, Game MONUSCO, named for the United Nations Organization Stabilization Mission in the Democratic Republic of the Congo and designed at the Norwegian Military Academy to develop the strategic mindsets of military students. The article introduces prominent literature on matrix games, to which it adds an elaborated account on the way post-play discussions are exploited to help students gain specific and general educational learning outcomes. Central to this effort, and a novel contribution to the literature, is a strategic-bridge model. This model, informed by Daniel Kahneman's seminal work on intuitive and analytical thinking, promotes a strategic mindset compatible with NATO doctrines. In addition, we argue military students gain professionally relevant experiences by repeatedly applying theoretical knowledge to solve the kind of practical problems matrix games can generate. This serves to aid and improve the making of informed decisions. Game-experiences also help these future officers to become familiar with chance, uncertainty, and other crucially important features of the military profession. Preliminary evaluations indicate matrix games to be a valuable educational method for the achievement of such learning outcomes in professional military education and suggest the method can be relevant for other professional studies as well.

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**KEYWORDS:**

wargames; matrix games; military education; strategy; heuristics; officer competence; decision making

**TO CITE THIS ARTICLE:**

Roennfeldt, C. F., Helgesen, D. E., & Reutz, B. A. H. (2022). Developing Strategic Mindsets with Matrix Games. *Scandinavian Journal of Military Studies*, 5(1), pp. 257–268. DOI: https://doi.org/10.31374/sjms.132

While the authors, who also organized Game MONUSCO, are convinced that matrix games offer an efficient educational method, we acknowledge that no systematic and thorough assessment exists to support this claim. Our conviction finds support, however, in anonymous questionnaires, such as the one conducted after the 2021 game executions. Here all 30 participating cadets reported on a 5-option Likert scale – (1) disagree; (2) partly disagree; (3) neutral; (4) partly agree; (5) agree – the extent to which they agreed with a set of statements relevant to the above stipulated educational goals. The results expressed as a percentage of the participants are displayed in the following table:[6]

| STATEMENTS | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **a)** The game has focused my attention more towards what I am supposed to achieve (end-focus). | 3 | 3 | 7 | 33 | 53 |
| **b)** As a result of the game, I have learned more about how to think to achieve ends. | 0 | 7 | 0 | 53 | 40 |
| **c)** The game is an efficient learning method to achieve several of the learning outcomes in the module complex operations. | 0 | 0 | 7 | 10 | 83 |
| **d)** What I have learned from the game will be relevant when I am to lead and conduct operations. | 0 | 0 | 7 | 23 | 73 |
| **e)** What I have learned from the game will be useful in military planning processes. | 0 | 0 | 17 | 40 | 43 |
| **f)** The game has enhanced my understanding of what it implies to operate in a complex environment with many actors and many divergent interests. | 0 | 0 | 0 | 3 | 97 |

**Table 1** Percentage of cadets stating the extent to which they agreed with listed propositions (N = 30). Data gathered in February 2021 from anonymous questionnaires using a 5-option Likert scale: (1) disagree; (2) partly disagree; (3) neutral; (4) partly agree; (5) agree.

It is interesting to note that while the vast majority of cadets "agree" or "partly agree" that Game MONUSCO helps them develop a strategic mindset, as shown in Table 1's point (a) and (b), they find the game even more useful for the achievement of the learning outcomes of the module listed above and to the overall bachelor education – see points (c), (d), and (f). We shall now introduce Game MONUSCO and show how it is played.

## THE MATRIX GAME MONUSCO

Game MONUSCO is a variant of matrix games.[7] Håvard Fridheim at the Norwegian Defence Research Establishment offers Figure 1 that situates this category of game concept within the broader context of wargames.[8]

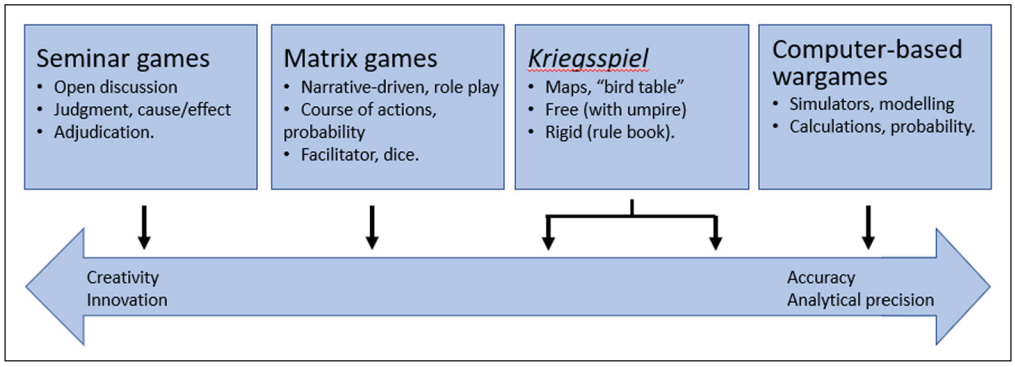


**Figure 1** Fridheim's categorization of wargames, as illustrated in Alme (2020: 19).

Figure 1 categorizes wargames on a scale of parameters with creativity at one extreme and analytical precision at the other. From this perspective, those game-organizers wanting a creative game triggering open discussion and innovative problem-solving are guided towards seminar games;[9] those who want to use games to gain a better understanding of relations between different variables in different scenarios (when planning military force structures, for instance) are advised to use data-supported wargames (Evensen et al., 2022). Matrix games are closer to seminar games and often used for educational purposes (Rothweiler, 2017; Curry, 2018, pp. ix–xii).

6 These figures are from the physical, rather than the digital, version of Game MONUSCO. See below for an explanation of this distinction.

7 Other variants can be found in Curry & Price (2014) and Brynen, Mouat, and Fischer (2017).

8 Sabin (2014: xviii, pp. 1–5), Elg (2018, p. 129), and Pournelle (2017, pp. 49–51) deliver three alternative frameworks for categorizing wargames.

9 For an introduction to seminar games, see, for instance, Pournelle (2017, p. 50).

DOI: 10.31374/sjms.132

Engle (2018, p. 16) invented matrix games as a game concept where a so-called umpire (or game-referee) adjudicates players' actions according to matrices of words rather than on the numbers and statistics commonly used in *kriegsspiel* and computer-based wargames. The British Armed Forces' wargaming handbook describes the concept:

> Matrix games demand that players provide several specific arguments for the success of a proposed action. These are limited only by player imagination and feasibility. Other players can then make counterarguments. If opposed, a short discussion leads directly to an adjudication outcome. Debates are time-limited to allow multiple actions and counteractions in the game, so that the participants are forced to live with the consequences of their decisions over time. As the scenario permits, players are free to negotiate with each other, with completely open-ended outcomes. These characteristics stimulate free-thinking creativity and novel outcomes from the narrative generated in the game. Matrix games rely on an experienced facilitator/umpire who leads players through the process, suggesting moderations that the group can then discuss. (British Ministry of Defence, 2017, p. 40)

Game MONUSCO shares many of these game features. In particular, it is the various actions and counteractions made by players that determine how the game scenario develops; these developments generate new situations for the players to deal with. Players also provide arguments to explain why they are capable of carrying out a specific action – in the example above, for instance, setting up a roadblock. In Game MONUSCO, however, players do not provide counterarguments; as these are found to be less relevant in achieving learning outcomes, the umpire offers instead the counterarguments as explained below.

We shall now show how Game MONUSCO played out in class in February 2021 and establish some empirical examples which we can later use to illustrate more abstract ideas.

## PLAYING THE GAME

Game MONUSCO is designed to give cadets a practical sense of the challenges that may unfold at the lowest tactical level in a UN peacekeeping operation. The game spurs cadets to use the module's theoretical knowledge to deal with such challenges in a competent manner. It was played eight times in both digital and physical formats during a week in 2021. While both formats received good feedback, they were organized differently. Here we focus on the latter format to avoid complicating the presentation unnecessarily.

A game involved up to 15 cadets and was managed by teachers: a facilitator, an umpire, and a hot wash-up moderator charged with facilitating the post-game discussion. Each cadet only played a single game. It took 11 hours and was divided into three successive phases.[10] Each phase had about 90 minutes play followed by a hot wash-up of some 90 minutes in which cadets reflected and discussed their game experiences. Figure 2 shows the timetable of a game:

| Hrs | Activity |
|---|---|
| **0800** | **Phase One:** Getting started |
| 0815 | First cycle in which all players shall: develop a course of action (15 min); roll dice (10 min); receive a situational update (5 min) - all cycles follow this pattern. |
| 0845 | Second cycle |
| 0915 | Third cycle |
| 0945 | Break |
| 1000 | Hot wash-up |
| 1100 | Lunch |
| **1200** | **Phase Two** continues from the outcome of third cycle. Again, three game cycles (90 min), short breaks, and a hot wash-up (75 min) |
| 1500 | Dinner |
| **1600** | **Phase Three** continues from the outcome of sixth cycle. Now with two game cycles (60 min), short breaks and an extended final hot wash-up (105 min) |
| 1845 | Evaluation of game day |
| 1900 | End of game |

**Figure 2** Timetable of a matrix-game day.

10 Normally, matrix games last 3–4 hours; see Mouat (2020, p. 17) and Price (2018, p. 35). Since it is during this course NMA cadets are introduced to matrix games, we have decided to let them play three successive games (here called phases) to become accustomed to the educational method and to enhance their learning.

Teachers introduced cadets to Game MONUSCO two weeks in advance, as the course's peacekeeping module began. We gave every cadet a two-page general introduction to the scenario and, individually or in a team of up to three, specific information about their precise role in the game.

The scenario was set in the eastern part of the Democratic Republic of Congo (DRC), more specifically in Tumbula, a village of some 6,000 inhabitants close to the Ugandan border. Tumbula was meant to represent a microcosm of the much broader conflict in DRC. The game had five players: a commander (NOR) of Norway's company-size contingent to MONUSCO, a village chief, a DRC army battalion commander, a local militia leader, and a visiting BBC journalist. Each role was defined in a few confidential paragraphs with three unique objectives each player-team should achieve during the game. The objectives were designed to offer the teams options for both cooperation and conflict: the protection of civilians, for instance, was the objective of NOR and, to a degree, the village chief, but not of the local militia leader. At the same time, both the village chief and the militia leader had vested, but not necessarily common, interests in cross-border smuggling traffic. Cadets were tasked with dedicating a full day to prepare for the game. In particular, they were directed to take note of their presumptions about the other players' objectives and actions, and to clarify their own courses of action to achieve their objectives with this in mind.

From the perspective of the participants, a gameday unfolded as follows. The cadet entered a room with five posts – one for each player-team. The game's facilitator presented the schedule of the day along the lines of the timetable in Figure 2. At the start of every game-cycle, each team had 15 minutes to come up with their course of action and arguments to convince the umpire that they would be able to carry it out. Subsequently, an umpire circulated among the teams. Each team presented the umpire their proposed course of action and arguments. The umpire evaluated the arguments, came up with potential counterarguments, balanced the pro- and con arguments to determine how probable it was that the proposal would succeed, and translated that probability into spots on a dice. On a scale from two to six, the umpire estimated a course of action's realism; two dice spots indicated a highly realistic proposal, six spots a course of action deemed highly unlikely to be realised. The team then rolled the dice, and the umpire recorded the result. Having done this with all teams, the umpire summarized the results in a plenary update on the game scenario and the hot wash-up moderator would inject additional events when necessary for the learning process. Then players launched into a new cycle of course of action proposals, pro-arguments, and dice-rolling.

## POST-PLAY LEARNING IN HOT WASH-UPS

After three play-cycles, each lasting some 30 minutes, the players gathered for a hot wash-up – the analytical and most intellectually demanding part of the game. For educational purposes, this is arguably more important than the initial playing part; in what follows, we would like to unfold how we sought to inspire cadets to reflect on game experiences as a means to achieve both specific and more general learning objectives. Among these learning objectives are a grasp of the difficulties related to understanding what happens in a complex operation and to responding in a strategic manner, and an appreciation of the role played in armed conflicts by bad luck, time restraints, friction, and uncertainty – in brief, a host of considerations that experienced officers are only too familiar with.

### DEVELOPING STRATEGIC MINDSETS

To help cadets gain a strategic mindset, the NMA has developed a "strategic-bridge model." This combines academic literature on strategy with Daniel Kahneman's (2012) seminal work on the role of heuristics in decision making.[11] Crucially, the model is compatible with the conceptual combination of ends, ways, means, and risks which direct NATO's planning procedures at all levels of command (NATO, 2019, paragraphs 3.1–3.2).

Before presenting the model in more detail, more clarification is needed on how cadets use it during a hot wash-up and how this contributes to their learning processes. The example of

11 On the use of academic literature to develop strategic mindsets in professional military education, see Roennfeldt (2020).

DOI: 10.31374/sjms.132

Cadet K playing the role of NOR is useful here. As her game was coming close to its conclusion, she decided to request MONUSCO air support to counter the threat of an imminent invasion of Tumbula by the Islamist militia Allied Democratic Forces (ADF), a regional and superior group infamous for grossly violating human rights (Bahati and El-Bay, 2021). She presented the decision to the umpire in the form of an order: "To win the clash with ADF, I order two of my platoons and request MONUSCO special forces and attack helicopters to eliminate ADF's command posts."

During the subsequent hot wash-up, the cadet analysed this course of action by filling in the blank "Way," "End," and "Assumption" boxes in the strategic-bridge model (see Figure 3). On a whiteboard she visualized the strategic idea of her course of action in the following manner:

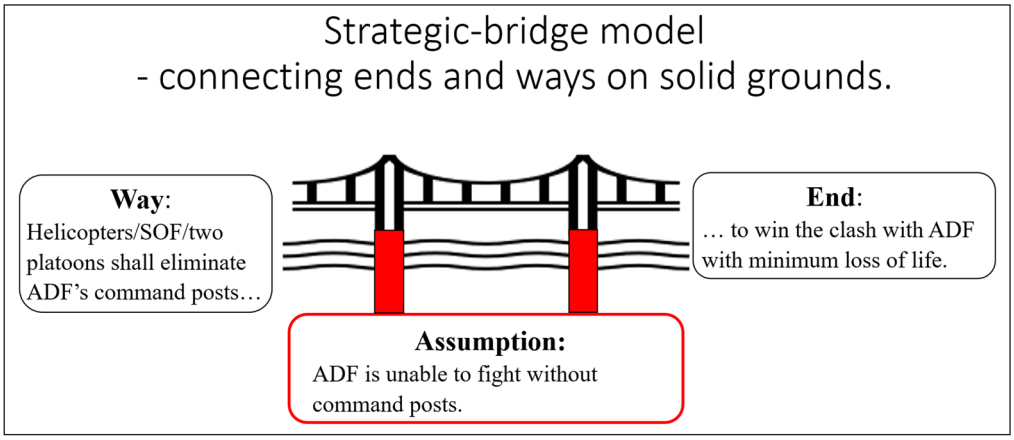


**Figure 3** NMA's strategic-bridge model applied to visualize the logic and assumption of a proposed course of action.

The subsequent feedback from teachers and cadets initially focused on the logic of NOR's strategic idea. Having confirmed that three components – way, end, and assumption – were logically connected, we continued to discuss whether NOR's reasoning was sound. The model highlights her central assumption that the ADF will be unable to fight without command posts. We discussed whether this could be supported or challenged by scholarly work. One participant held that while this assumption is widely supported in literature on conventional force-on-force warfare, literature on post-Cold War peacekeeping operations suggests the assumption is not necessarily valid for non-governmental militias such as the ADF, with their blurred lines of command and control.[12] NOR referred to a text in the syllabus that indeed stipulates that "predatory groups," including the ADF, have a chain of command and can be significantly weakened if such chains are disrupted (Kjeksrud, Beadle, and Lindqvist, 2016, p. 12). Whether this is actually so is less important in this educational game. What is important is that the cadet should develop a logically consistent course of action which they can defend by drawing on external sources or generally accepted knowledge. On the substance we concluded that a better understanding of a militia's mode of operation could improve NOR's chances of winning the firefight.

We continued to consider other aspects of NOR's course of action. While access to the requisite means was not an issue, since these had already been obtained, we discussed the risks involved in their use – notably sending a relatively small number of MONUSCO ground forces into a fight against an estimated 1000 ADF-irregulars. Literature on UN peacekeeping operations in Bosnia and Somalia during the early 1990s suggests that the risk involved in NOR's course of action was high.[13] We also brainstormed alternative ways to identify and destroy key targets. NOR eventually decided to use attack helicopters only, although she believed that this approach would reduce her chances of identifying critical targets.

Against this background, we will now clarify the model's design and theoretical underpinnings.

For pedagogical reasons we have designed a model that cadets can immediately grasp, apply within a day, and subsequently remember. Moreover, NMA requires a model that develops mindsets applicable in highly variable NATO contexts, from seeking successful outcomes in a minor firefight to strategic political ends. Arthur Lykke's understanding of strategy as a plan to balance ends, means, and ways satisfy these criteria (Echevarria, 2017, pp. 5–6). Along the lines Cadet K demonstrates

12 See, for instance, United Nations Department of Peacekeeping Operations (2008, p. 32).

13 The incident of two U.S. helicopters shot down by Somali rebels in 1993 is a well-known case (see Bowden, 1999). Former force commander of the UN peacekeeping operation in Bosnia in 1995, Gen. Rupert Smith (2005, p. 351) reflects on risks and consequences of peacekeepers being taken as hostages.

above, we find cadets gradually adopt an appropriate strategic mindset by repeatedly filling in the model's blanks while continuously seeking to establish a logical and convincing connection between ways and ends. Feedback from teachers and students can support such learning processes, as shown above. Indeed, "means" do not form part of the model, having been excluded in order to keep the model simple. Obviously, cadets take means into account, and the umpire checks whether the necessary means are available to carry out any specific course of action. Similarly, "risks" do not form part of the model, either; although risk is a component in the NATO conception of strategy, we have not worked out how to add a risk component without compromising the model's pedagogical simplicity. Fortunately, as we see above, cadets intuitively discuss risks when they evaluate strategic ideas; this suggests that this component need not necessarily be included.

We do find it vital, however, that the strategic-bridge model should highlight key assumptions. Strategies must be based on credible assumptions if they are to be held to be sound. To convey this message, the model illustrates that, just as columns must be built on solid ground to bear the weight of a physical bridge, arguments must be based on sound assumptions.

The theoretical inspiration for our treatment of assumptions is derived from the study made by Kahneman (2012) of the role played in decision-making by heuristics. Heuristics form part of the cognitive process humans apply to decide how to go about things. As the title of his principal work *Thinking, Fast and Slow* conveys, the terms refer to the assumptions humans make in decision-making under time constraints. Kahneman (2012, pp. 20–21) famously argues that human decision-making draws primarily from what he terms cognitive System 1, guided by the fast, effortless, and intuitive use of heuristics, and occasionally from the slower System 2, which is more analytical and demands concentration. People use System 1, for instance, when saying that 2+2=4, or when solving everyday tasks like commuting from home to our place of work. But we begin to call on System 2 when we have to find the sum of more complicated multiplications, like 17 × 24, or, to continue the example above, if our car breaks down on the way to work and we have to find alternative ways to get there. Thus, we generally speed up our decision-making processes based on our knowledge, experience, and belief about what is most likely to be a correct answer or a sound judgment in a given situation (Kahneman, 2012, pp. 97–98). Heuristics may be considered rules of thumb, mental shortcuts, and cognitive biases.

Kahneman's distinction between cognitive System 1 and System 2 seems useful in helping cadets develop a strategic mindset, particularly since intuition plays an important role in military decision-making.[14] This can be highly useful when there is little time to reflect, such as in the rare-but-critical instances when soldiers are caught under fire. Indeed, such examples underscore the importance of training and drills, if only to survive. Kahneman stresses, however, that we can also be very badly guided by our heuristics if we fail to realize in advance that our intuitive approach will not solve a task at hand. "The way to block biases that originate in System 1," he recommends, "is simple in principle: recognize the signs that you are in a cognitive minefield, slow down, and ask for reinforcement from System 2" (Kahneman 2012, p. 417).

The strategic-bridge model aims to help cadets recognize when they need reinforcement from cognitive System 2 and seems particularly useful during military planning when there is time to analyse and refine alternative courses of actions. A case in point is the above-mentioned feedback to Cadet K's assumption in her course of action. We critically examined the question "Will the ADF's fighting power be significantly reduced if we destroy their command posts?" To help find an answer, we pointed to scholarly work, including syllabus material from this and other modules, to support our propositions. Cadets noted that although this was a bit tiresome, a few minutes of knowledge-based discussion about such assumptions could help them use means in ways more likely to achieve desired ends. More generally, the model prompts cadets to fully think through their strategic ideas, to critically examine their assumptions, and to find support for their choice of ways with professional knowledge. K and other cadets experienced that by making reference to some generally accepted knowledge their arguments came across as sounder. They learned to reason. It is here we find the general utility of matrix games in professional military education: cadets apply academic knowledge in practice to make informed decisions.

14 Stressing the importance this feature of military competence, Clausewitz (1984) used the French term *coup d'oil* to describe such rapid, accurate, and sound "decision taken in the midst of action."

## GENERAL LEARNING OUTCOMES

During the hot wash-ups, cadets also discussed game-related observations relevant to the broader learning outcomes of their officer education. This includes the high degree of complexity, danger, and stress officers experience in armed conflicts. The following sections unfold how the hot wash-ups were used to help cadets enhance their situational awareness, to appreciate the role of chance, and to accept the uncertainty that characterizes the exercise of the military profession.

Before embarking on these broader themes, it is informative to briefly introduce how the role of hot wash-up moderator is carried out. Prior to the game, we prepare a list of potential themes particularly relevant to the learning outcomes. During the play-cycles, the moderator is primarily an observer taking note of game-events that can illustrate these themes. As shown below, however, the moderator takes a leading role in the hot wash-ups by organizing discussions about selected game-events and by helping cadets to reflect on these events in the context of the military profession.

## ENHANCING SITUATIONAL AWARENESS

Along with the educational goals stipulated above, we designed Game MONUSCO to prepare cadets for operating in complex environments. In the previously mentioned questionnaire, 97% of the cadets agreed and 3% partly agreed with the statement that "the game has enhanced my understanding of what it implies to operate in a complex environment with many actors and many divergent interests" (see Table 1).

Prior to the game, cadets were tasked with filling in a table stipulating their expectations of the other players' objectives and behaviour, as well as the possible implications for the cadets' own courses of action. Moreover, during the game the facilitator occasionally tasked cadets to reconsider their perceptions of the other players and to adjust their individual tables accordingly. In the final hot wash-up, cadets revealed how their perceptions of the other players' objectives and behaviour had changed during the game, and offered explanations.

Only after the last game-cycle, for example, did the BBC journalist realize she narrowly avoided being killed by the local militia because she went to Uganda to escape the ADF. "I was aware you avoided me," she commented, "but not that you wanted to kill me." Another cadet turned this non-event into a more general discussion: "My understanding of others' objectives changed several times. It is difficult to know why people act the way they do." A third cadet followed up: "And we know each other well. Imagine how this will be in a far-away operation, when we must make assumptions about people we do not know, with a body language we are likely to misunderstand, and in a culture so different from ours."

A related discussion occurred in a different hot wash-up that brought home the maxim that to solve a problem, one must first understand it. A teacher opened by asking why this game had relatively high numbers of reported rapes. Most players had acted on the assumption that the local militia carried out the rapes. For instance, NOR, with a mandate to protect civilians, had increased patrols in the village based on the assumption that the militia raped for lust and would continue until someone prevented them from doing so. These patrols did not turn out to be particularly useful, however. Another cadet suggested that players had *weaponized* rape to undermine the legitimacy of local authorities in the village.[15] The local militia team confirmed they had introduced rapes into the game, but for reasons other than those suggested. Their course of action was informed by a web-search indicating that that local militias in the region apparently believe rape to make fighters invincible in battle.

These two simple examples illustrate how we believe matrix games can help cadets appreciate the importance of situational awareness and of understanding the context in which they operate. They also illustrate the kind of discussions that may inspire cadets to realize the value of professional competence in a broad sense of the term.

### Appreciating the Role Played by Chance in the Military Profession

Another educational spin-off is the capacity for matrix games to highlight the role chance plays for the military profession. Frequently cadets experience that even relatively well-reasoned

15 Sitkin, Bandy, and Grace (2019) argue that such sexual violence has been used to achieve ends of policy in armed conflicts.

courses of action, which the umpire deems likely to succeed, fail to materialize successfully due to the fall of the dice. We use this element of dice-rolling in matrix games to spur cadets to reflect on how plain luck, or the lack of it, will affect their professional life.

During hot wash-ups, we would brainstorm on meticulously planned military operations that have failed. A famous example is the pre-World War I Schlieffen Plan (Badsey, 2000, p. 41). A less-known example is the Norwegian mechanized International Security Assistance Force troop that went to a remote village in north-west Afghanistan to eliminate Taliban only to learn that the rebels had left that same day (Boe, Kjørstad, and Werner-Hagen, 2012, pp. 159–174). We could also change perspective and point at less-planned operations that have succeeded; at a tactical level, for instance, we might consider the successful British offensive on Goose Green led by a major during the Falklands War in 1982 (Frost, 1988). In another, from 1994, a Norwegian second lieutenant in the UN peacekeeping operation in Bosnia successfully led the evacuation of some 300 hospitalized patients under fire (Norwegian Armed Forces, 2014). A historic and evocative example is Caesar's crossing of the Rubicon. "The die is cast," he famously commented – apparently acknowledging the role of chance in military operations (in this case, the invasion of Rome).

As in so many other military discussions, Clausewitz's outlook was brought to the table in this year's hot wash-up. This included his "trinity" – the suggestion that the character of a war is shaped by the dynamic interaction of rationality, chance, and passion (Clausewitz, 1984, book 1 chapter 1 section 28). It was noted that Game MONUSCO comprises each of these elements with, respectively, argumentation, the fall of a dice, and each player's emotions. The fact that all games ended differently having set out from the same point of departure accords with Clausewitz's understanding of war. This fact suggests that matrix games can be a useful way for cadets to become familiar with this key feature of their profession. Moreover, while recognizing the role of chance, we also emphasized the trinity's element of rationality: the individual's ability to strike a well-reasoned course of action also matters for the outcome of matrix games and, more importantly, of wars.

We like to believe such hot wash-up discussion help cadets "identify with the responsibility the military profession and the officers have," which also aligns with a general learning outcome in NMA's bachelor education (NDUC, 2021). The element of uncertainty, which Clausewitz (1984, book 1 chapter 1 section 18) holds to be a crucial feature of the military profession, was also discussed in the hot-wash up that will now be introduced.

## Accepting the Feature of Uncertainty in the Military Profession

Above, we showed just how difficult it is to base a courses of action on relevant and generally accepted assumptions. Our specific feedback on Cadet K's strategic idea continued into discussions on more fundamental matters, however. With regard to the syllabus text Cadet K referred to, another cadet critically noted that it provides no empirical evidence in support of its claim. Other parts of the course had emphasized that irregular armed groups have blurred lines of command and that its members often pursue personal gain.[16] This would suggest that, regardless of whether or not the ADF's command posts were destroyed, the assault on Tumbula's civilians would continue until other players physically stopped the irregulars. Someone pointed to the severe limits of our knowledge of the ADF's mode of operations and how these operations might be disrupted. We questioned whether generally accepted knowledge exists on such tactical matters, and therefore whether generally valid claims could be made. A cadet argued that military intelligence gathered at tactical level was better suited to evaluate the quality of assumptions underpinning such proposed course of action.

These discussions led to more general reflections on the character of the military officer's expertise as compared to that of the engineer and doctor. Some suggested that the engineer's field of knowledge is more reliable because it is evidence-based and can be supported by mathematical calculations, whereas military officers must decide on matters that change from one situation to another. Arguably, the medical doctor's expertise falls somewhere in between: although patients vary, human anatomy is, with a few important exceptions, similar. These discussions called for a more elaborate lecture comparing the humanities, the social sciences, and the natural sciences. Unfortunately, the moderator had not prepared for that.

16 See, for example, Berdal and Keen 1997, pp. 797–800.