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PERFECT IS THE ENEMY OF GOOD: RECOGNITIONAL DECISION-MAKING IN THE CANADIAN ARMY

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Perfect is the Enemy of Good: Recognitional Planning in the Canadian Army

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ABSTRACT

The CA currently employs a concurrent option comparison model of decision-making known as the Operational Planning Process. It is a reductionist approach to decision-making that seeks to make optimal decisions by creating multiple courses of action and comparing them. This process takes significant time while failing to create optimized plans. Studies in the naturalistic decision-making field have identified the ability of expert decision-makers, to include military officers, to make good decisions rapidly through the use of intuition. This paper argues that the Canadian Army must implement a recognitional planning model along with the training initiatives required to enable it. The paper examines the fields of heuristics and biases research and naturalistic decision-making to gain an understanding of human cognition. The nature of war is then investigated to understand how planning works within the context of war. The faults of the Operational Planning Process are discussed to establish the requirement for change with the paper concluding with a discussion on the specific initiatives that need to be instituted to better prepare Canadian Army leaders for future operations.

INTRODUCTION

But it was all a gamble, anyway. War always is.

- Lieutenant-General Sir Frederick Morgan, Chief of Staff Supreme Allied Command, regarding operation OVERLORD.

In December of 1944 as German forces tore through American lines in the Ardennes in the beginning of what would become the Battle of the Bulge, General Patton sat with his staff to plan the 90-degree turn north for 3rd Army's counter attack into the German salient. Within an hour and fifteen minutes they had planned three lines of attack to be executed by code word based on the results of his meeting with Generals Eisenhower, Bradley, and others later that morning. The attendees of that meeting were stunned by the speed at which 3rd Army was going to be able to achieve this attack, which eventually defeated the German offensive.[1]

Standing along the bank of the Han river in 1950 General Douglas MacArthur intuited that a deep amphibious landing against North Korean forces would have a decisive effect against their offensive operations.[2] His previous experience in amphibious operations and his knowledge of historical Japanese amphibious operations allowed him to select his target as the exceptionally difficult port of Inchon.[3] Despite significant resistance by the Joint Chiefs of Staff, MacArthur convinced them of his plan and landed at Inchon, collapsing North Korean resistance around the Pusan Perimeter and driving North Korean force back North of the 38th parallel.

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[1] Patton, George S., Paul D Harkins, and Beatrice Ayer Patton, *War as I Knew It*, (Boston: Houghton Mifflin Company, 1947), 190-191.

[2] Joint Chiefs of Staff, *Joint Military Operations Historical* Collection, (Washington D.C.: Joint Chiefs of Staff, 1997), II-4.

[3] *Ibid.*; William Manchester, *American Caesar: Douglas MacArthur 1880-1964*, (Boston: Little Brown, 1978), 574.

In Kuwait in 1991 the 1st UK Armoured Division conducted offensive operations against the Iraqi Army. At 1758 on 26 February the division gave orders to its 4 Armoured Brigade to attack Objective Tungsten. At 2330 the Brigade began its attack and reported Tungsten as secure by 0558 the following morning.[4] 4 Armoured Brigade required only five and a half hours of battle procedure to execute its attack. In the Marines' area of operations the Tiger Brigade of 116 Abrams tanks and 54 Bradley fighting vehicles prepared to seize the Al Mutla Pass, denying Iraqi forces the ability to escape north. At 0730 the Brigade commander gave orders over the radio that the attack would begin at 0930. "Between 0730 and 0930, the Brigade's mission, boundaries and final objective changed five separate times!"[5]

Twelve years later in Iraq, Col Dunford's Regimental Combat Team 5 (RCT-5) was to pass through the 3rd Light Armored Reconnaissance unit and continue the attack up Highway 1. To accomplish this, he gave a set of radio orders at 0730 to his Regiment of 5,000 Marines and 1,000 vehicles. It ordered the passage of lines and the attack to commence a mere hour and a half later. The order was eighty-one words and nine sentences in length.[6]

How is it that these decision-makers were able to make such successful decisions so quickly, often with a paucity of information? Why were they able to do so in the absence of many of the current formalized processes? How were they able to convey complex ideas in short orders that allowed large formations to execute rapidly? This paper will answer these questions.

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[4] 1 UK Armoured Division radio logs.

[5] Lieutenant Colonel John F. Antal, "It's Not the Speed of the Computer that Counts! The Case for Rapid Battlefield Decision-Making," *Armor*, (May-June 1998): 12.

[6] Major Cole F. Petersen, "The Plan and First Contact: Command in the 1st Marine Division, Iraq 2003," (Masters Thesis, Marine Corps University, 2017), 19.

The Canadian Armed Forces (CAF), and the Canadian Army (CA), along with all their allies, employ a concurrent option comparison model of planning and decision-making. This model is known as the Operational Planning Process (OPP). OPP and all similar planning models rely on a linear, rational, reductionist approach to problem solving where the problem is identified, factors are evaluated, potential solutions are generated and then compared, and then a solution is selected from the proposed courses of action. Evidence and experience, however, indicate that often this is not the way in which decision-making occurs in training and operations.[7] There is a divergence between what the CA states should take place when planning for operations and what actually takes place.

Many commanders and staffs do not strictly adhere to a concurrent option comparison approach, for a variety of reasons. These include the time required to conduct the process, the rapid speed of operations which often outpaces planning efforts and, perhaps surprisingly, the fact that these models are not well suited to dealing with complexity.[8] There is then a gap between that which is taught and that which is actually executed.

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[7] Matthew Lauder, "Systemic Operational Design: Freeing Operational Planning from the Shackles of Linearity," *Canadian Military Journal*, 9 No. 4 (2009): 43; Gary Klein, "Strategies of Decision-making," *Military Review*, (May 1989): 56; Dr David J. Bryant et al., "Synthesizing Two Approaches to Decision-making," *Canadian Military Journal*, (Spring 2003): 30.

[8] Jim Storr, "Timelines and Timeliness," *The British Army Review*, No 146, (Spring 2009): 54.; Lauder, 43; Klein, "Strategies of Decision-making," 56; Peter Thunholm, "Planning Under Time Pressure: An Attempt Toward a Prescriptive Model of Military Tactical Decision-making," in *How Professionals Make Decisions*, ed. Henry Montgomery, Raanan Lipshitz, and Berndt Brehmer, (Mahwah NJ: Lawrence Erlbaum Associates, Publishers, 2005), 44; Gary Klein, *Sources of Power How People Make Decisions*, (Cambridge MA: MIT Press, 2017) 17, 20; Bryant et al., 30; Patrick C. Mulloy, "Penetrate Uncertainty: Descriptive Planning in a Complex Tactical Environment," The Strategy Bridge, https://thestrategybridge.org/the-bridge/2019/9/2/penetrate-uncertainty-descriptive-planning-in-a-complex-tactical-environment; Nassim Nicholas Taleb, *The Black Swan the Impact of the Highly Improbable,* 2nd ed, (New York: Random House, 2010), 16; Klein, *Sources of Powers*, 261-271; Gary Klein, *Streetlights and Shadows Searching for the Keys to Adaptive Decision-making*, (Cambridge, MA: MIT Press, 2011) 81-82; William Duggan, *Coup d'Ooeil: Strategic Intuition in Army Planning*, (Carlisle, PA: Strategic Studies

Concurrent option comparison models stand in contrast to recognitional models of decision-making. Recognitional models eschew the comparison of multiple options in favour of selecting a single option and assessing it for suitability prior to selection.[9] These models, also known as naturalistic decision-making, rely heavily on decision makers' intuition and their ability to recognize a situation as typical from previous experience allowing them to create and select a solution rapidly.[10] This use of intuition is critical to these models and their capacity for rapid decision-making.

There are other models of decision-making that rely more on experience and a decision-maker's ability to rapidly recognize an acceptable solution based on experience. The CA, however, does not have a doctrinally acknowledged recognitional decision-making model. All models employed by the CA are concurrent option comparison models such as the OPP and the Estimate. Despite this, CA doctrine does recognize the value of intuition in decision-making. *Command in Land Operations, Command Support in Land Operations,* and *Decision-making at the Tactical Level* all explicitly recognize the value of intuition in decision-making.[11] *Command in Land Operations* goes the furthest stating that there are two separate, yet complementary, approaches to decision-making, an analytical approach, and an intuitive approach.[12]

Institute, 2005), 16; Ben Zweibelson, "'The Enemy Has a Vote' and Other Dangers in Military Sense-Making," *Journal of Military Operations* 2 No 2, (Spring 2014), 22, https://www.tjomo.com/article/39/The_Enemy_has_a_Vote_and_Other_Dangers_in_Military_SenseMaking/.

[9] Klein, *Sources of Power*, 17, 20.

[10] *Ibid.*, 17-31.

[11] Department of National Defence, B-GL-335-001/FP-001 *Decision-making and Planning at the Tactical Level,* (Ottawa: Department of National Defence, 2017) 1-1; Department of National Defence, B-GL-331-001/FP-001 *Command Support in Land Operations* (Ottawa: Department of National Defence, 2008), 6-6; Department of National Defence, B-GL-300-003/FP-001 *Command in Land Operations,* (Ottawa: Department of National Defence, 2008), 2-14 – 2-16.

[12] Department of National Defence, B-GL-300-003/FP-001 *Command in Land Operations,* 2-14 – 2-16.

In coming to grips with complex scenarios, the CA only has the OPP and Estimate processes. These processes rely on reductionist analysis of individual factors to determine tasks, limitations, and requirements for coordination. Such approaches are for simple and complicated problems and are poorly suited for situations of complexity.[13] The CA lacks any specific process for tackling such complex situations.

Despite the challenges of analytical, concurrent option comparison problem solving models and the fact that CA doctrine recognizes the value of intuitive decision-making there is still no recognized model to leverage the intuition built upon the experience and judgement of leaders. This leaves CA planners and commanders insufficiently prepared to make decisions where they may fully leverage their personal experience. Further, there is a gap in planning methodologies to help staffs and commanders in gaining an understanding of complex environments outside of the Mission Analysis and Estimate processes.

This paper will tackle these issues with a view to making recommendations for how the CA can improve its doctrine and training to better prepare its leaders to plan and make decisions in the contemporary operating environment (COE). This paper argues that the Canadian Army must implement a recognitional planning model to complement existing processes along with the training initiatives required to enable it. This will require the CA to implement models and training to better prepare leaders to apply intuition to planning and mission execution, improving the familiarity of CA leaders with rapid decision-making.

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[13] Dr David J. Bryant et al., 30; Patrick C. Mulloy, "Penetrate Uncertainty: Descriptive Planning in a Complex Tactical Environment," The Strategy Bridge, https://thestrategybridge.org/the-bridge/2019/9/2/penetrate-uncertainty-descriptive-planning-in-a-complex-tactical-environment, accessed 27 November 2019; Nassim Nicholas Taleb, *The Black Swan,* 16; Gary Klein, *Sources of Power*, 261-271.

The fields of decision-making and complexity flourish outside the military, so this paper will employ sources from a variety of fields of study to highlight commonalities across disciplines. As part of this, both recognitional and concurrent option comparison models are well established. All of Canada's major allies employ a concurrent option comparison model for problem solving similar to OPP. These models vary in terms of the names and numbers of steps; however, all the major components are similar. These include the identification of the problem, a reductionist analysis of relevant factors, the production of multiple courses of action, and the comparison of those options to achieve an optimal solution.[14] Due to this commonality, this paper treats evidence from Canada's major allies as equivalent to that of Canada and draws freely upon them throughout the argument. The steps of the various processes for comparison are in the figure below.

[14] North Atlantic Treaty Organization, AJP-5 *Allied Joint Doctrine for Operational-Level Planning*, (North Atlantic Treaty Organization, 2013), 3-1; Joint Chiefs of Staff, JP 5-0 *Joint Planning*, (Washington D.C.: Department of Defence, 2017), V-2; Department of the Navy, MCDP 5-10 *Marine Corps Planning Process*, (Washington D.C.: Headquarters United States Marine Corps, 2016), 1-1; Department of the Army, ADRP 5-0 *The Operations Process*, (Washington D.C.: Headquarters Department of the Army, 2012), 2-12; Commonwealth of Australia, ADFP 5.0.1 *Joint Military Appreciation Process*, (Canberra: Department of National Defence, 2019), 1-2; Ministry of Defence, JDP 5-00 *Campaign Planning*, (Swindon: Ministry of Defence, 2013), 2-36.

Canadian and Allied Planning Methodologies						
Canadian Operational Planning Process	**NATO Operational Level Planning Process (OLPP)**	**US Joint Planning Process**	**US Marine Corps Planning Process (MCPP)**	**US Army Military Decision Making Process (MDMP)**	**UK Operational Estimate**	**Australian Joint Military Appreciation Process (JMAP)**
1. Initiation	1. Initiation of the OLPP	1. Planning Initiation	1. Problem Framing	1. Receipt of Mission	1. Understand the Operating Environment (Framing the Problem)	1. Scoping and Framing
2. Orientation	2. Problem and Mission Analysis	2. Mission Analysis	2. COA Development	2. Mission Analysis	2. Understand the Problem (includes Mission Analysis, factor analysis, and Comd's confirmation)	2. Mission Analysis
3. COA Development	3. COA Development	3. COA Development	3. COA Wargaming	3. COA Development	3. Formulate Potential COAs	3. COA Development
4. Plan Development	4. COA Analysis	4. COA Analysis and War Gaming	4. COA Comparison and Decision	4. COA Analysis (War Game)	4. Develop and Validate COAs	4. COA Analysis
5. Plan Review	5. COA Validation and Comparison	5. COA Comparison	5. Orders Development	5. COA Comparison	5. Evaluate COAs	5. Decision and Concept of Operations Development
	6. Commander's COA Decisions	6. COA Approval	6. Transition	6. COA Approval	6. Commander's Decision	
	7. Operational level of concept of operations and plan development	7. Plan or Order Development		7. Orders Production, Dissemination, and Transition		
	8. Campaign Assessment and Plan Review/Revision					

Figure 0.1 -- Comparison of Planning Methodologies Between Canada and Major Allies/Partner

Source: See footnote 8.

This paper employs a qualitative analytical approach and is broken into four chapters. The first chapter will examine how humans make decisions. To do this it will examine research from the heuristics[15] and biases school of human decision-making and will rely heavily on the work of Daniel Kahneman. The chapter will also look at the work of Gary Klein and his findings on how experts make decisions. Chapter one will provide the background to understand how humans make decisions for the remainder of the paper.

Chapter two explores the realities of human decision-making in the context of the military environment, discussing complexity and the nature of war. The implications of this to planning and decision-making will demonstrate the limitations that the uncertainty of military operations place on purely analytical decision-making models as well as the opportunities that are offered by intuitive methods.

Chapter three will address the failings of current approaches to planning and decision-making. The chapter will examine optimization versus satisficing, the planning processes' ability to deal with complexity, and the lack of training in the CA for intuitive decision-making. This chapter will establish the requirement for change within the CA.

The final chapter will discuss the implications of the previous discussion to include several recommendations for change. These recommendations include the adoption of a recognitional planning methodology as well as the process of design to better cope with complexity, changes to training, the use of baseline data to help discipline intuitive impressions, and how artificial intelligence (AI) might be employed in the future to better improve planning efforts.

[15] A heuristic is a simplified process that allows decision-makers to find workable, but imperfect, solutions to problems. Daniel Kahneman, *Thinking Fast and Slow,* (Anchor Canada, 2011), 98.

These arguments will establish the requirement for change in how the CA currently conducts planning and decision-making. In particular, it will highlight the requirement to recognize an intuitive decision-making process, establish training practices that will support such a process and adopt a means by which to better deal with complexity. These measures will improve the decision-making and planning capabilities of CA leaders.

CHAPTER 1: HOW HUMANS MAKE DECISIONS

Genius is no more than recollection.

- Napoleon

Two schools of thought dominate the study of human decision-making. The heuristics and biases group studies the shortcuts and biases that limit human ability to reason. The naturalistic decision-making group examines the ways in which intuition, particularly expert intuition, allows rapid and suitable decision-making. It is around expert decision-making that these two groups most often disagree. The most prominent scholars in these fields are Amos Tversky and Daniel Kahneman for heuristics and biases and Gary Klein for naturalistic decision-making.

This chapter will look at these two fields of study to illustrate their findings regarding decision-making. The heuristics and biases field will be examined followed by naturalistic decision-making. The final portion of the chapter will examine where these two fields have come to agreement. The findings of this chapter will develop the foundational knowledge and context for the remainder of the paper as well as frame and help the reader to understand CA decision-making in later chapters.

System 1 and System 2 Thinking

Kahneman's research on decision-making has divided human cognitive functions between two systems, known simply as System 1 and System 2.[16] These two systems are approximate groupings of functions within the brain. While it is not technically accurate to say that any specific judgement belongs to either, they are useful approximations for different approaches to decision-making based on cognitive functions.[17]

[16] Kahneman, 19-30.
[17] *Ibid.*, 29-30.

System 1 operates in the background, subconsciously, on a continuous basis providing instantaneous impressions, and emotions.[18] It is automatic and functions with little to no conscious effort.[19] System 1 is responsible for functions such as, understanding simple language and math problems, making spatial judgements like one object being closer than another, reactions to sudden sights and sounds, and recognition of stereotyped situations.[20]

System 2 is conscious, effortful, and is associated with the self.[21] Its use requires attention and when attention is broken the process is interrupted.[22] System 2 is responsible for functions such as, focusing one's attention on a particular person in a noisy room, giving someone a phone number from memory, searching memory for the name of an acquaintance whom you have forgotten, and doing long division.[23]

These two systems interact to provide humans with their decision-making faculties. According to Kahneman:

> System 1 runs automatically and System 2 is normally in a comfortable low-effort mode, in which only a fraction of its capacity is engaged. System 1 continuously generates suggestions for System 2: impressions, intuitions, intentions, and feelings. If endorsed by System 2, impressions and intuitions turn into beliefs, and impulses turn into voluntary actions. When all goes smoothly, which is most of the time, System 2 adopts the suggestions of System 1 with little or no modification.[24]

When System 1 finds itself in a situation where it does not have the resources to solve a problem or that contravene its model of the world, System 2 activates, and attention

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[18] *Ibid.*, 20-21.
[19] *Ibid.*
[20] *Ibid.,* 21.
[21] *Ibid.*
[22] *Ibid.,* 22.
[23] *Ibid.*
[24] *Ibid.*, 24.

focuses on the issue.[25] Kahneman describes this coordination between Systems 1 and 2 as follows:

> The division of labor between System 1 and System 2 is highly efficient: it minimizes effort and optimizes performance. The arrangement works well most of the time because System 1 is generally very good at what it does: its models of familiar situations are accurate, its short-term predictions are usually accurate as well, and its initial reactions to challenges are swift and generally appropriate.[26]

Problems arise in this division of labour, however due to the fact that System 1 is prone to the use of heuristics and demonstrates biases. The fact that System 2 is effortful and demonstrates behaviour of being hesitant to engage compounds the problem. Kahneman describes this as System 2 being "lazy."[27] This means that System 1 often makes the decision, while System 2 simply confirms what System 1 has already determined.[28]

System 1's primary function is to create a coherent story that accounts for the world around it along with the memories it accesses.[29] This makes it liable to believe most statements. A by-product of this, in conjunction with System 2's tendency for laziness is that humans often display a bias for confirmation of existing beliefs. Further, when other tasks distract System 2 or it is otherwise depleted, it will not check the narratives produced by System 1, leaving decision-makers liable to believe something they might not normally believe.[30] This combination of a lazy System 2 and a System 1 whose primary objective is to create coherent narratives is a recipe for rushing to judgement and confirmation bias.[31] There are numerous consequences. Overconfidence in intuitive judgements is common, as the quality or source of information is not relevant to

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[25] *Ibid.*
[26] *Ibid.*
[27] *Ibid.*, 31.
[28] *Ibid.*, 45.
[29] *Ibid.*, 88.
[30] *Ibid.*, 83.
[31] *Ibid.*, 86.

System 1 it is the coherency of the narrative produced that matters most.[32] As the information is not important, its presentation has a significant impact on the way it is perceived. This is known as framing. Presenting the same information in different ways will provoke different reactions from System 1 and result in significantly different responses.[33] Further, as System 1 only uses the information it has immediately it has a tendency not to use data from similar cases to make accurate estimates.[34] System 1's desire for a coherent story and tendency for System 2 to not check System 1's impressions indicates there are challenges to people's ability to conduct analysis and make rational decisions.

The functioning of System 1 and the interactions between it and System 2 leave humans open for various types of heuristics and biases beyond those already discussed. Included among these biases is the tendency to focus more on the content of a message than its reliability.[35] There is also the phenomenon of anchoring. Anchoring takes place when irrelevant data reviewed prior to an estimate influence the outcome.[36] Lastly there is availability, where people will rate certain categories higher the more easily they can recall relevant memories.[37] The cumulative impact of these biases along with framing, a lazy System 2, and a System 1 that seeks narrative coherence above all else, is humans experiencing significant difficulty in making accurate predictions of likelihood based on statistical probabilities.

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[32] *Ibid.*, 87.

[33] Daniel Kahneman and Amos Tversky, "Choices, Values, and Frames," *American Psychologist*, 39 No 4 (April 1984): 343-344.

[34] Daniel Kahneman, *Thinking Fast and Slow,* 87.

[35] Amos Tversky and Daniel Kahneman, "Belief in the Law of Small Numbers," *Psychological Bulletin*, 76 No 2, (1971): 109-110.

[36] Amos Tversky and Daniel Kahneman, "Judgement under Uncertainty: Heuristics and Biases," *Science*, New Series 185, No 4157 (Sept 27 1974): 1128-1129.

[37] *Ibid.,* 1127-1128.

This tendency to do sense making in hindsight gives humans a perception that they understand the factors that have conspired to lead to their current situation. Their confidence in this narrative is based solely on its coherence, regardless of the quality of the evidence and, thus, leads to a sense of certainty about one's ability to predict the future, and resultant overconfidence.[38] Professionals are not immune to this sense of overconfidence. Paul Meehl wrote the pioneering work in this field that demonstrated that simple algorithms are more accurate than experts in several fields. His book reviewed numerous studies which examined quantitative to non-quantitative prediction methods amongst professionals to determine which were more accurate.[39] All but one study found the algorithm to be superior or at least as good as the professional.[40] Professionals being outperformed, or equaled, by algorithms include clinical psychologists making diagnoses, school counselors predicting student performance based on previous grades and personal interviews, and a prison physician predicting criminal recidivism.[41] Similarly, Kahneman was able to create an algorithm to improve the results of personnel selection officers in the Israeli Defence Force screening new applicants for combat duty, and Princeton economist Orley Ashenfelter created another which outperformed wine experts ability to predict the price of wine several years in the future.[42] Kahneman also examined the investing outcomes of twenty-five financial advisors over eight years. He ran correlations between performance each year to determine performance and found that there was no

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[38] Kahneman, *Thinking Fast and Slow,* 209, 218.

[39] Paul E. Meehl, *Clinical vs. Statistical Prediction: A Theoretical Analysis and a Review of the Evidence*, (University of Minnesota, 1954), 83-128, https://pdfs.semanticscholar.org/4d7d/0731f04aaf579efc74b20c559ac8e004622b.pdf

[40] *Ibid.*, 109.

[41] *Ibid.*, 90-94, 112-113.

[42] Kahneman, *Thinking Fast and Slow,* 229-232; Orley Ashenfelter, "Predicting the Quality and Prices of Bordeaux Wine," *The Economic Journal*, 118, (June 2018): F181.

connection between performance and skill.[43] "The results resembled what you would expect from a dice-rolling contest, not a game of skill."[44] In accordance with the overconfidence that comes from hindsight, and professional interests, all of these findings have encountered resistance within their respective professional circles.[45]

Naturalistic Decision-Making

Heuristic and bias advocates and naturalistic decision-making supporters diverge most over the topic of the intuitions of experts and how much they should be trusted. Naturalistic decision-making advocates see value in the mental models and intuitions of experts within specific fields. Further differentiating the two fields is how they pursue their studies. While heuristic and bias researchers conduct much of their studies within controlled experiments in laboratories, naturalistic decision-making scholars conduct their research in the field with their subjects in complex, dynamic environments. Gary Klein is the leading researcher in this field and has done significant work on fire fighters and military commanders and their staffs.

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[43] Daniel Kahneman, *Thinking Fast and Slow,* 212-216.

[44] *Ibid.*, 215.

[45] Paul E. Meehl, "Causes and Effects of My Disturbing Little Book," *Journal of Personality* Assessment, 50, No 3 (1986): 371-373, http://meehl.umn.edu/sites/meehl.dl.umn.edu/files/132causeseffects.pdf; Peter Passel, "Wine Equation Puts Some Noses Out of Joint," *The New York Times*, 4 March 1990, https://www.nytimes.com/1990/03/04/us/wine-equation-puts-some-noses-out-of-joint.html; Kahneman, *Thinking Fast and* Slow, 229, 231. Similarly, an argument has been made for the requirement for checklists to support the decision-making of professionals in complex environments. Atul Gawande has led this argument in the field of surgery and achieved impressive results including a 36% reduction in surgical complications and 47% reduction in deaths. See, Atul Gawande, *The Checklist Manifesto: How to Get Things Right*, (New York: Picador, 2010), 79. This perspective has also encountered professional resistance, see cclark@healthleadersmedia.com, "Gawande on Checklists: Why Don't Hospitals Use Them?" *HealthLeaders*, 3 Feburary 2011, https://www.healthleadersmedia.com/clinical-care/gawande-checklists-why-dont-hospitals-use-them.

A critical point for naturalistic decision-making researchers, which heuristic and biases scholars agree with them on, is that intuition is a matter of pattern recognition.[46] Highly experienced decision makers are able to identify a situation as typical or non-typical very rapidly and align it with experiences from their past.[47] This allows skilled decision makers to visualize prototype solutions to the problems which they face.[48] As experts create these mental models, they envision and assess one at a time as opposed to doing multiple simultaneously and comparing them. This is a critical difference. They will then select the first that has a reasonable chance of working.[49] This approach is known as *satisficing*, meaning that the selected approach simply satisfies the requirements for a course of action.[50] This is in contrast to analyzing multiple courses of action, which seeks to choose an optimal solution. Decision-making models and optimality will be discussed in chapter 2.

Supporting the development of these courses of action is the ability for skilled decision makers to be able to visualize the execution of these solutions. Visualization supports the decision maker in determining whether the course of action is in fact satisfactory but also allows for an analysis of the option through its execution.[51] These simulations tend to focus on only a few critical parts of the course of action, usually about three, and would move through approximately six transitions or steps through the envisioned solution.[52] Simulating the right details using the limited memory and cognitive capabilities of the human mind in itself requires a measure of expertise in the

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[46] Gary Klein, *Sources of Power*, 17, 15-31, 145-146; Kahneman, *Thinking Fast and Slow*, 236-237.

[47] Klein, *Sources of Power*, 17.

[48] *Ibid*.

[49] *Ibid*.

[50] *Ibid*., 20.

[51] *Ibid*., 49.

[52] *Ibid*., 56.

process being imagined. It cannot be overly nor under detailed and the right factors must be focused upon to ensure that waste of limited cognitive capacity on factors or processes of reduced importance does not take place.[53]

Expertise has others important impacts on decision-making. Experienced decision makers see the relationships between various elements of situations as they further refine their mental models. This allows them to see relationships where novices cannot.[54] This understanding of relationships between various factors permits them to identify which factors are particularly critical while also developing expectancies of what should happen. With this sense of expectancies experts can identify when something has not happened that would have otherwise been expected. Novices do not experience this, as they lack the mental model to be able to expect what the next typical event might be.[55] The competencies of experts are part of a larger capability to see the bigger picture within a particular situation, to judge whether it is typical or not, and to understand the causal relationships within it.[56]

Experts are of course, not immune to the problems of System 1 thinking. The critical difference is that experts have accumulated a body of knowledge that allows their System 1 processes to propose emotions, impulses, mental models, and courses of action that are appropriate to the situation the decision-maker finds themselves in. System 1 thinking seeks to create coherent narratives, therefore these processes also happen in non-experts, as described earlier in the chapter. The critical difference, however, is that for a novice their impulses are not based on a relevant body of experience.

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[53] *Ibid*., 57.
[54] *Ibid*., 154.
[55] *Ibid*., 155.
[56] *Ibid*., 156.

Klein and his associates have studied numerous groups in real word conditions to arrive at their findings that recognition is used by people to make decisions and that this approach is effective in arriving at rapid and adequate solutions to problems. Klein's most prolific work is with firefighting scene commanders. He describes one situation where the commander arrives on the scene of a reported basement fire. Seeing no smoke or flames the commander investigates the back door to see flames moving up the laundry chute. He sends fire fighters to the second and third floors and reports the fire is past them. The commander now sees smoke coming out of the eaves of the roof where there had been none previously. The commander instantly diagnoses that the fire has gone all the way up the chute, hit the ceiling, and is now pushing smoke down the hallways. He now must switch to a search and rescue and securing an evacuation route.[57] In this case the commander was able to observe a few limited cues, diagnose the situation, and describe the required course of action to resolve the situation. He describes a similar scene in which a fire fighter enters a house with his team to extinguish what they believe to be a kitchen fire. Upon entering the home, the team sprays the fire but finds little impact. The firefighter then has a feeling that something is not right and orders his team out. The floor they were standing on collapses immediately after they leave the room. It turns out the fire was in fact in the basement. Interestingly this fire fighter cannot initially describe what triggered him to withdraw his team, only that he had a bad feeling. After the conduct of several interviews, what was found was that he noted that the room was hotter and quieter than what he expected. That, in conjunction with how the fire did not react to the water, betrayed his expectations and indicated to him that the situation was

[57] *Ibid*., 61.

other than what he had been expecting, triggering him to withdraw his team.[58] These cases describe a very different situation than the stock pickers, school counsellors, clinical psychologists, prison physician, and the wine experts. These anecdotes are at the heart of the differences between these two schools of thought.

In analyzing his findings, Klein created the Recognition Primed Decision Model. In the model a decision maker recognizes a situation or parts of a situation as familiar to create a mental model of a potential solution based on their experience. The model sees relevant cues, expectancies, plausible goals, and actions as the products of recognition, which allows for mental simulation to determine the feasibility of the solution. If the problem is unfamiliar then the decision-maker will look to clarify elements of the situation.[59] The model is depicted in figure 1.1, below.

[58] *Ibid*., 34-35.
[59] *Ibid*., 27.

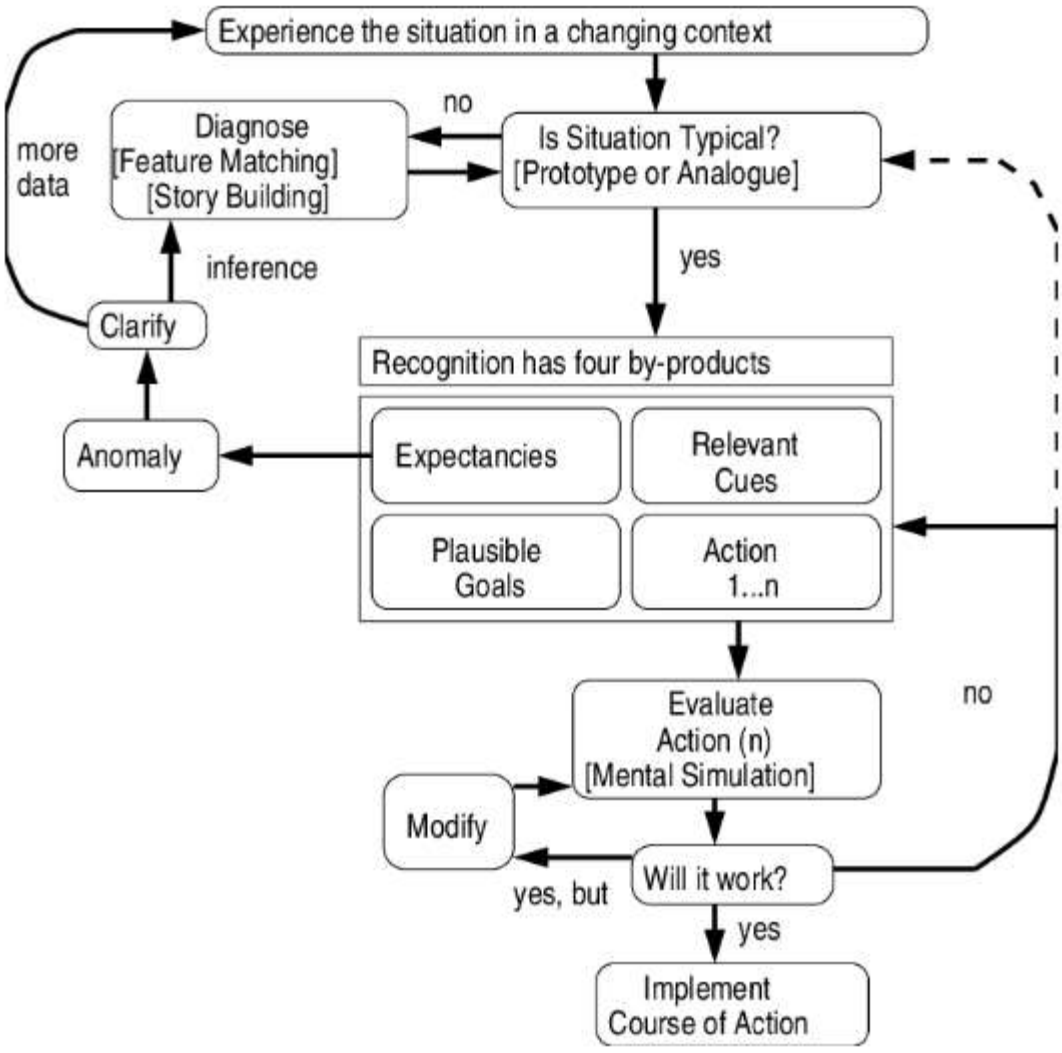

Figure 1.1 – Klein's Recognition Primed Decision Model

Source: Klein, *Sources of Power,* 27.

Further refining this work, Klein applied his research directly to a military context. In conjunction with United States Marine Corps officer John Schmitt, they described the Recognitional Planning Model (RPM) for the military. This model sees the decision maker leveraging intuition in creating a single conceptual course of action during the first step, which is largely unchanged from mission analysis. This option would then be further analyzed and operationalized in step two by the decision maker or

the staff, allowing for the use of Type 2 thinking to refine the intuitive solution. Step three is a wargame to further improve the plan, with the last step being the development of orders.[60] Chapter 3 and 4 will discuss this approach to planning in greater detail and a simplified version in figure 1.2 is below.

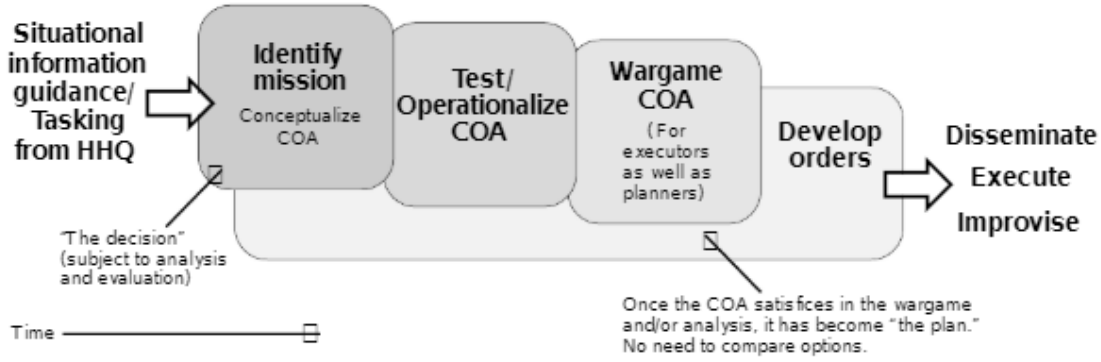

Figure 1.2 – The Recognition-Primed Decision Model

Source: Karol Ross et al., "The Recognition Primed Decision Model," 7.

Despite the significant limitations in human cognition found by the heuristics and biases school of research, some experts can make rapid and appropriate decisions. They do this without an exhaustive analysis of factors, and they do not bother attempting to optimize by comparing multiple courses of action. Klein takes it a step further in his later work in arguing that heuristics and biases are appropriate adaptations to many problem-solving situations:

[60] John Schmitt and Gary Klein, "A Recognitional Planning Model," (unpublished paper from 1999 Command and Control Research and Technology Symposium, 1999), 5-9; Karol Ross, et al., "The Recognition-Primed Decision Model," *Military Review* (July – August 2004): 7.

> We wouldn't use anchoring to make estimates. But where would our estimates come from, if not from previous cases that we remember? We wouldn't frame situations when we tried to size them up. But framing just means we use a mindset to judge what is relevant. Without mindsets, we would have to look at every cue, every data element in a scene and consciously decide whether it was relevant. That sounds like a lot of work. It sounds like it would paralyze us, especially in complex situations… No one has ever demonstrated that our judgements would be improved if we could be de-biased. No one has ever compared what we would lose versus how much we would gain by giving up any of the reasoning strategies.[61]

Heuristics and biases, while capable of threatening the ability of humans to make clear-headed decisions, are also important to managing the information required for decision-making. There is in fact a great deal of agreement between Klein and Kahneman on just when we can trust human judgement.

The Requirements for Valid Intuitive Expertise

After several years of collaboration, Klein and Kahneman published a joint article in *American Psychologist*, entitled, "Conditions for Intuitive Expertise: A Failure to Disagree." In this article, they address some of the critical differences between these two schools of thought and seek to answer the question of, the conditions under which expertise can develop, and intuition can be trusted.

Interestingly, they note that their strongest differences were more emotional than intellectual. Klein's inclination was to be impressed by the intuitive abilities of experts while Kahneman was more inclined to find "pleasure in demonstrations of human folly and in the comeuppance of overconfident pseudo experts."[62] They also note that this division reflects across researchers within their respective schools and the tendency for

[61] Gary Klein, *Streetlights and Shadows Searching for the Keys to Adaptive Decision-making,"*(Cambridge: MIT Press, 2011), 60-61.

[62] Daniel Kahneman and Gary Klein, "Conditions for Intuitive Expertise A Failure to Disagree," *American Psychologist* 64 No 6 (September 2009): 518.

scholars between the two schools to not interact likely reinforces the views of each camp.[63] This is an indicator that the division between these two schools is based more upon the inherent biases and preferences of those who choose to select either of these disciplines versus what either has to say about human decision-making.

The naturalistic decision-making and heuristics and biases schools also pursue their research in very different methods. Heuristic and biases researchers execute laboratory based controlled experiments with layman subjects, while naturalistic decision makers conduct their research in the field with practitioners.[64] The different approaches to research results in very different perspectives on human cognition and what experts can achieve. Ultimately, it reflects the cultural divide between the two approaches.

This approach to research also results in different perspectives on expertise. While heuristic and biases researchers execute laboratory-based research where they can achieve quantifiable results, naturalistic decision-making researchers are not able to benefit from the same level of quantification in the field. This means that their "criteria for judging expertise are based on a history of successful outcomes rather than on quantitative performance measures."[65] Further, heuristics and biases researchers often apply a criterion of optimization within their experiments. Optimality is a much more demanding criterion than is usually used by researchers of naturalistic decision makers.[66] This difference in criteria for judging the quality of decisions leads to very different perspectives on expertise.

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[63] *Ibid*.
[64] *Ibid*.
[65] *Ibid*., 519.
[66] *Ibid*.

As mentioned previously, both schools of thought see skilled or expert intuition as recognition. This implies two things. “First, the environment must provide adequately valid cues to the nature of the situation. Second, people must have an opportunity to learn the relevant cues.” There is a further implication. “Skilled intuitions will only develop in an environment of sufficient regularity, which provides valid cues to the situation.” Klein and Kahneman use the term ***validity*** to describe the idea of the regularity of an environment. It refers to “the causal and statistical structure of the relevant environment.” The environment, therefore, is critical to the role that intuition can reliably play in decision-making. Klein and Kahneman use the examples of a building on fire, a nurse assessing an infant, and selecting stocks to illustrate what they mean. In the case of the burning building and the infant, there are likely cues that the building may collapse or that the infant may have an infection. In the case of selecting stocks, however, the price already reflects any publicly available information, thus there is no indicator whether the price will rise or fall further. Based on this, there are different environments in which different experts operate that are more or less valid and hence present the opportunity for the use of intuition. Importantly, high validity does not necessarily mean a lack of uncertainty. Certain situations maybe about identifying statistical likelihoods. This is comparable to knowing what a good and a bad bet is in games of chance.[67] The concept of a highly valid but uncertain environment has obvious implications for the environment of war. Chapter 2 will discuss this further.

Conclusion

[67] *Ibid*.

This chapter has examined the most important approaches to human decision-making in the heuristics and biases and naturalistic decision-making schools. The heuristic and biases camp study decision-making in laboratories with nonprofessional subjects. Their findings demonstrate the significant limitations of human cognition and how they affect human decision-making. The naturalistic decision-making school does its research in the field on skilled practitioners. Their findings show that experts in some fields can make quick, suitable decisions.

Kahneman and Klein's work together has demonstrated that these schools of thought may not be so far apart as initially thought and human factors in researcher's preferences accounted for much of the separation. Importantly they agree that **intuition is a matter of recognition**.[68] People identify cues from the situation they face that allow them to draw on memories to determine if the situation is typical or not.[69] Further this means that the environment in which decisions are being made must be sufficiently valid for decision-makers to be able to accumulate enough knowledge to effectively employ intuition.[70] Uncertainty in the situation does not necessarily imply a lack of validity.[71]

The question remains: is warfare a sufficiently valid environment for intuitive decision-making. If intuition is to be effectively applied to decision-making in warfare, then relevant cues must be present in the environment for the decision-maker to detect and then draw upon similar situations resident in their memory to create a potential solution. There is also the requirement for decision makers to have the opportunity to develop the expertise to recognize these cues and develop a body of practice to give them

[68] *Ibid*., 520.
[69] *Ibid*.
[70] *Ibid*.
[71] *Ibid*.

the required mental models. Chapter 2 will address the issue of the validity of the environment of warfare, and therefore, the applicability of intuition to decision-making in that environment.

CHAPTER 2: RECONCILING MILITARY OPERATIONS WITH HUMAN DECISION-MAKING

> *The correctness of Clausewitz's perception has both kept his work relevant and made it less accessible, for war's analytically unpredictable nature is extremely discomfiting to those searching for a predictive theory.*
>
> – Alan D. Beyerchen

This chapter will seek to reconcile the nature of war with planning. Planning requires a modicum of foresight, and some practices in planning tend towards attempts to predict the future, to include enemy actions, and to choreograph friendly activities. War is a highly complex phenomenon, with uncertainty being one of its defining characteristics. The complexity and uncertainty make confident prediction in war and warfare almost impossible. As noted in the previous chapter, however, uncertainty does not necessarily mean that intuition would be of no value in an environment. The value of intuition will be a measure of the validity of that environment. Validity is a matter of the statistical regularity of causation within an environment and a decision-maker's ability to detect and learn cues within the environment despite uncertainty.[72] This chapter will look to determine the validity of warfare as a phenomenon. This will allow for a determination on how applicable intuition is to decision-making in the conduct of operations.

This chapter will examine this issue in the following manner. First, warfare will be examined as a complex, unpredictable phenomenon. Warfare will be established as a complex system and complexity theory applied. A discussion will follow demonstrating that war is a high validity, high uncertainty environment where intuition plays a significant role. Lastly, their will be a discussion of the implications.

War as a Complex Phenomenon

War has been understood to be a complex and unpredictable endeavor since humanity began critically analyzing it as a phenomenon. Speaking of the difficulties of

[72] Kahneman and Klein, 520.

war, Clausewitz stated, "everything in war is very simple, but the simplest thing is difficult."[73] In this he was referring to his concept of friction which accounted for things like physical exertion, fear, danger, chance and uncertainty which accumulate to make taking action in war difficult.[74] In considering Clausewitz's vaunted trinity of "primordial violence, hatred, and enmity… the play of chance, and of its element of subordination, as an instrument of policy, which makes it subject to reason alone," fully two thirds are made up of irrational elements: the Clauswitzian view of war was that it was a fundamentally uncertain enterprise.[75]

In this environment, military forces seek to achieve political objectives through the use of force. "War is not merely an act of policy but a true political instrument, a continuation of political intercourse, carried out with other means."[76] In employing force in the pursuit of compelling the enemy to accept their will, military forces create plans for the employment of their forces. This speaks to the rational portion of the trinity; yet, the significant irrational elements remain to act upon the environment. In this way, we can see how governments employ military forces in the pursuit of rational policy objectives, while military forces create rational plans to employ force. Both these endeavors, however, must act within an environment rife with friction, and uncertainty that will resist them achieving their objectives and acting in the manner foreseen.

Canadian doctrine has taken a similarly Clauswitizian view based on operational experiences. *Land Operations* states "even in its most straightforward form, land combat

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[73] Clausewitz, Carl Von, *On War*, translated by Michael Howard and Peter Paret, (Princeton, NJ: Princeton, 1984): 119.

[74] *Ibid.* 104, 119-120.

[75] *Ibid.*, 89.

[76] *Ibid.*, 87.

is a complex and dynamic undertaking."[77] *Land Operations* identifies a number of enduring characteristics of land warfare as uncertainty and chaos, violence and danger, friction, and human stress.[78] These characteristics lead to an environment characterized by complexity and unpredictability.[79]

In addition, continuing in a Clausewitzian vein, *Land Operations*, sees the use of force as being tied to the achievement of political objectives. Nested at the top is national strategy with a descending series of rational objectives. National strategy sets national objectives, while military strategy allocates the resources and determines the manner in achieving them.[80] This leads to the development of operational level objectives and the development of a campaign plan.[81]

There is a great deal of concurrence between Clausewitz's analysis of war, stemming from his experiences fighting Napoleon and Canadian doctrine, which reflects Canadian operational experience. Further, the Canadian doctrinal view is not unique. Canada's major allies share similar perspectives on the nature of war and the role that complexity and uncertainty play in its execution.[82] This analysis shows that there is a similar perspective on war across time and different practitioners. This discussion, however, gives no guidance on the value of intuition and the ability of a practitioner to gain expertise within this environment. Common to all these interpretations of war is the

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[77] Department of National Defence, B-GL-300-001/FP-001 *Land Operations*, (Ottawa: Department of National Defence, 2008), 2-17.

[78] *Ibid.* 2-17 – 2-19.

[79] *Ibid.* 2-19 – 2-20.

[80] *Ibid.*, 2-5.

[81] *Ibid.*

[82] Department of Defense, JP 1 *Doctrine for the Armed Forces of the United States,* (Washington: Joint Chiefs of Staff, 2017), I-2 – I-4; Department of the Navy, MCDP-1 *Warfighting*, (Washington: Department of the Navy, 1997), 5-17; Ministry of Defence, *Operations*, (Shrivenham: Ministry of Defence, British Army, 2010), 3-3 - 3-3; Commonwealth of Australia, Land Warfare Doctrine 1 *The Fundamentals of Land Power,* (Australian Army, 2014), 11-15.

concept of complexity, which, seemingly, may complicate the role of intuition. It is to this that the paper will now turn.

Complexity Theory Applied to Warfare

Complexity is a broad field of study with implications in numerous disciplines. Due to applicability to such a wide variety of fields there are numerous interpretations of complexity and how to address it. This portion of the paper will examine several different perspectives to provide a broad context on complex problems and how the concept can be used to describe war.

Dave Snowden created the concept of the Cynefin framework to describe the variety of problems which decision makers may encounter. This framework divides problems into five different varieties based on their relationship to cause and effect. These categories are simple, complicated, chaos, complex, and disorder. Figure 2.1 displays the categories as well as some ways in which to approach problems in this domain.[83]

Simple problems have clear cause and effect. Solving simple problems allow for facts to be ascertained and how they relate to other elements of the problem. They can then be categorized for greater understanding which will then allow for the creation of a solution. Processing loan repayments would be an example of a simple context.[84]

Complicated problems also have a clear relationship between cause and effect although there might be multiple correct answers. In such a context, problem solvers can

[83] David J. Snowden and Mary E. Boone, "A Leader's Framework for Decision-making," *Harvard Business Review*, 85 No 11 (November 2007) https://hbr.org/2007/11/a-leaders-framework-for-decision-making

[84] *Ibid*.

categorize data, however, there is an increased requirement for analysis. Problem solvers in this type of environment must sense, analyze, then respond. This is the realm of good practice, vice best practice, as there are numerous good answers to the problem. Searching for oil or mineral deposits is an example as it will require the comparison of several different sites and an analysis to understand the effects at each.[85]

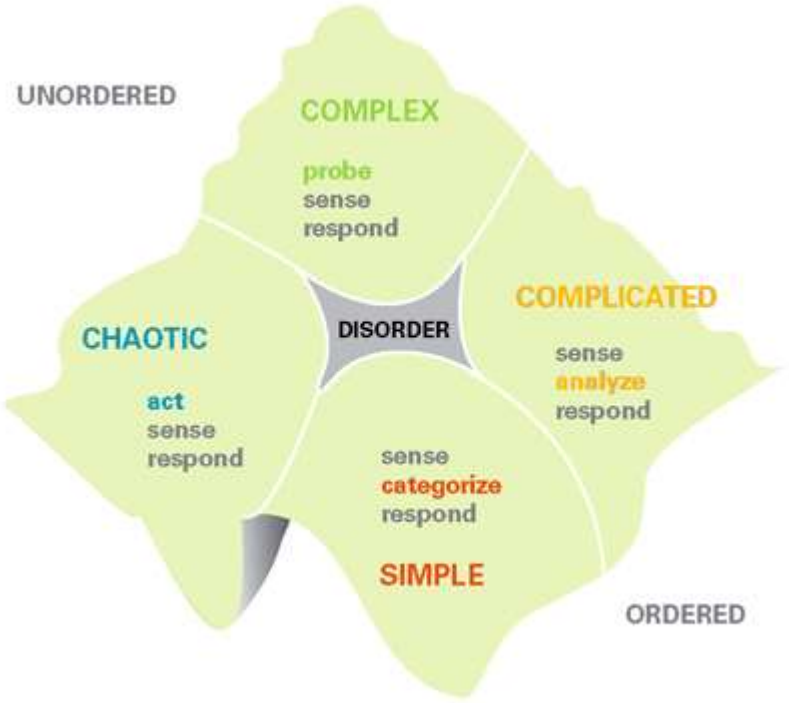

Figure 2.1 – Cynefin Framework

Source: Snowden and Boone, "A Leader's Framework for Decision-Making."

The chaotic domain describes disaster or crisis response. This is a situation where the relationship between cause and effect is impossible to determine because there is no clear relationship, or it keeps shifting. In such a situation a problem solver must look to

[85] *Ibid*.

establish order and then move the situation towards complexity by finding areas of stability.[86]

In the complex domain right answers are not apparent. Cause and effect are not clear and can only be understood in hindsight. As the system is more than the sum of its parts and there are numerous connections, it is self-defeating to categorize and pursue a reductionist approach. In such a system, problem solvers must probe, then sense the impacts of their probe, and then respond. This makes experimentation and adaptation important.[87] Complex problems are worth reflecting upon at further length.

Joachim Funke is a leading academic in the field of complex problem solving. He has identified five characteristics of complex problems that differentiate them from simple problems. First, is the complexity of the situation, which is generally defined by the number of variables within the system. This forces a problem solver to conduct some measure of simplification of the system. Second, is the number of connections between the various nodes. The more connections, the more complex the system. Third, is the "dynamics of the situation," which "explains the fact that interventions into a complex, networked system might activate processes whose impact was possibly not intended."[88] The characteristic also refers to the internal dynamics of the system that cause change due to its own internal dynamics which makes the situation time sensitive. Fourth, is intransparency regarding the workings of the system and even the problem solvers own goals. This means the problem solver must actively seek information within the system. Lastly, is polytely which refers to the fact that the goals a problem solver maybe seeking

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[86] *Ibid*.
[87] *Ibid*.
[88] Jochim Funke, "Complex Problem Solving," *Encyclopedia of the Sciences of Learning*, 38, edited by N.M. Seel, (2012), 683.

within a complex system maybe numerous and some of them maybe in conflict.[89] A simplified version used in management literature for the characteristics of complex systems is VUCA which stands for volatility, uncertainty, complexity, and ambiguity.[90]

Jim Storr, a retired British infantry officer, defence academic, and author of some of the UK Army's foundational doctrine, has put much of this discussion on complexity into military context. Storr's argument is that war is unimaginably complex. To illustrate his point, he uses the example of a simple infantry platoon of 30 personnel who could exist in a series of 5 different states: on leave, working, off duty, conducting guard duties, and imprisoned. To calculate the number of states that this platoon could exist in he uses the formula $p=n^m$, where p is the total number of states, n is the number of soldiers, and m is the number of states each soldier could be in. This means n equals 30 and m equals 5. This gives the platoon a total of 24,300,000 potential states in which it could exist.[91] This number of states explodes if the relationships between soldiers is accounted for with another power relationship.[92] Storr states:

> …the number of possible 'states of the world' for even a small part of an army is vast. If there is any change in the system at all, the number of subsequent states is also vast. Such arithmetic is known as a 'combinatorial explosion,' because it produces a very large number from a combination of a relatively small number of elements.[93]

Even small elements can result in great complexity which reveals why combat is not predictable.[94]

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[89] *Ibid.*

[90] Dietrich Dorner and Joachim Funke, "Complex Problem Solving: What It Is and What It Is Not," *Frontiers in Psychology*, 8 (July 2017): 2-3, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5504467/pdf/fpsyg-08-01153.pdf

[91] Jim Storr, *The Human Face of War*, (London, UK: Continuum, 2009), 41-42.

[92] *Ibid.*, 42.

[93] *Ibid.*

[94] *Ibid.*

While this may seem overwhelming, Storr gives practical guidance on how militaries manage complexity. The first is to reduce the number of actors or nodes. Looking at the platoon, interacting with it as an organization of three sections vice 30 soldiers reduces the number of potential states. Training for military leaders instructs them to do just this. Secondly, reducing the number of states in which each actor can be in (m) has a significant impact on reducing the overall number of states (p), as the number of states each actor or node can possess (m) is a power relationship.[95] To illustrate this point Storr uses the example of a division. A division may have 12 battle groups in three brigades. For planning and control purposes the division will concern itself with battlegroups while only tasking brigades. Those battlegroups could be in one of five states, attacking, defending, delaying, advancing, or in reserve. The total number of states in which the division could be operating in would be 258,832, or 12^5.[96] While still a large number of states in which a commander and staff must contend, this is much smaller than the potential states faced by the poor platoon commander who saw his organization as 30 separate individuals.[97]

Storr's analysis is a demonstration of complexity at work and how the military mitigates some of its effects through the good practices that have accumulated over years of operations. His examples of the platoon and division are, however, still a simplification. Neither the platoon nor the division accounted for relationships between actors.[98] These actors include friendly organizations, civilians, and most importantly the enemy. Nor does it account for the Clausewitzian frictions discussed earlier which will

[95] *Ibid.*, 44.
[96] *Ibid.*
[97] *Ibid.*
[98] *Ibid.*

make a complex environment even more difficult to deal with. War expressed as a mathematical equation is complex, however, it is even more complex in reality.

As a complex system, war possesses attributes of nonlinearity. Nonlinearity means that inputs to the system could have outputs out of proportion to the input. Nonlinear systems are also nonadditive meaning that the system is more than the sum of its parts.[99] Unlike a linear system where knowing a little about it allows you to understand how it functions, this is not possible with a nonlinear system.[100] This makes these systems highly sensitive to initial conditions and difficult to understand and predict.

Returning to Clausewitz, Alan Beycheren analyzed *On War* through the lens of nonlinearity and argued that while the concepts of nonlinearity post date *On War*, Clausewitz understood the concept and represented it in his book. He argues that unpredictability stems from three major sources. The first is interaction. This accounts for interaction between friendly and enemy elements and interactions within these elements. The interactions are dynamic and are bound up in each side trying to anticipate and preempt the other while also reacting to the others most recent actions.[101] Second is friction. As previously discussed, friction is the series of events and conditions which make executing operations difficult. Beyerchen points out that Clausewitz "emphasizes, however, the disproportionately large role of the *least* [original author's emphasis] important of individuals and of minor, unforeseeable incidents."[102] Clausewitz's friction speaks to the disproportionately of outcomes in war based on small input to the system

[99] Alan D. Beyerchen, 154-155.
[100] *Ibid.,* 156.
[101] *Ibid.,* 167-168.
[102] *Ibid.,* 173.

having outsized repercussions.[103] Lastly, is chance. These sources of chance, he argues, come from the fact that war as a system is very sensitive to initial conditions of which practitioners are unaware and cannot measure and hence cannot account for, and the tendency for practitioners to analyze war in a reductionist manner that causes them to lose sight of the whole.[104] Both factors leave practitioners blind to elements, potentially very small ones, of the operational environment that prevent them from fully understanding the overall system and leaving room for chance. In considering the nature of war these characteristics are constant, timeless, factors that decision makers must deal with. In analyzing *On War* through the lens of nonlinearity there is a great deal of overlap between what Clausewitz observed and advocated as the nature of war and complexity and nonlinearity. *On War,* and the elements of western doctrine that conform with its precepts, primarily the conceptual components, would appear to provide an accurate basis for understanding the phenomenon and its relationship with cause and effect.

Prediction

Relevant in the discussion of complexity and nonlinearity is that of prediction. The discussion thus far has focused on how the complexity of warfare makes prediction extremely difficult. This difficulty, however, is bounded temporally: the further into the future one attempts to forecast the less reliable one's predictions become. This does, however, imply that predictions will be more reliable the closer to the present they are made. This is due to the fact that the observer has a better sense of conditions of the system relevant to the problem at hand.

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[103] *Ibid.*
[104] *Ibid.,* 176-178.

This is an expression of the "Three Body Problem." Henri Poincaré, a physicist and philosopher, described the three-body problem which explains that the further into the future you attempt to predict about a system the more precision required regarding the initial conditions of that system.[105] The requirement for precision to accurately predict rapidly explodes, similar to Storr's "combinatorial explosion" in the complex system of an infantry platoon. Nassim Taleb in his book *The Black Swan* uses the work of mathematician Michael Berry to illustrate this requirement for increasing precision. To do this he describes a billiard ball on a table.

> If you know a set of basic parameters concerning the ball at rest, you can compute the resistance of the table (quite elementary), and can gauge the strength of the impact, then it is rather easy to predict what would happen at the first hit. The second impact becomes more complicated, but possible; you need to be more careful about your knowledge of the initial states, and more precision is called for. The problem is that to compute the ninth impact, you need to take into account the gravitational pull of someone standing next to the table… And to compute the fifty-sixth impact, every single elementary particle of the universe needs to be present in your assumptions! An electron at the edge of the universe, separated from us by 10 billion light-years, must figure in the calculations, since it exerts a meaningful effect on the outcome. Now, consider the additional burden of having to incorporate predictions about *where these variables will be in the future* [author's original emphasis].[106]

The billiard ball example reveals the true difficulty in prediction, however, in the realm of warfare practitioners do not have the luxury of dealing with inanimate objects. Instead, warfare is made up of human systems with their own will acting in opposition to another. This adds another significant component of complexity further complicating prediction.

A useful analogy for the ability to predict in warfare is the work that Per Bak and Kan Chen did on sand piles. The experiment was created to study the so-called critical states of these piles. They found that there is a common critical state for piles of sand

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[105] Taleb, 176-177.
[106] *Ibid*., 178.

expressed in terms of height and slope. Piles will naturally gravitate to this condition. To achieve the critical state, piles that have slopes that are sub-critical have small avalanches. Super-critical slopes have large avalanches.[107] They ran an experiment where sand piles would be created one grain at a time. These piles would always achieve the critical state, maintained through avalanches. In terms of prediction, the authors found that in studying a specific portion of the pile an observer "can easily identify the mechanisms that cause sand to fall, and he or she can even predict whether avalanches will occur in the near future."[108] If the observer's view expands, however, to encompass the entire pile, "large avalanches would remain unpredictable, however, because they are a consequence of the total history of the entire pile."[109] As both warfare and piles of sand are complex systems with sensitivities to initial conditions, similar to the three body problem, there is value in using the sand piles as an analogy for warfare. Decision-makers should, therefore, be aware that the accuracy of their forecasts are bounded by time and the elements of the system they are examining.[110]

Thus far the paper has established war as a complex phenomenon, meaning that making connections between cause, effect, and predictions is difficult. This complexity is a challenge to decision-making as detailed prediction is impossible, but the violence and risk involved in war nonetheless make detailed prediction highly alluring. What little

[107] Per Bak and Kan Chen, "Self-Organized Criticality," *Scientific American*, (January 1991): 48.
[108] *Ibid*.
[109] *Ibid*.
[110] Phillip Tetlock and Dan Gardiner have done research on the ability of humans to predict using forecasting tournaments. While they acknowledge the fact that the accuracy of predictions are bounded in time, they are the outside voices in just how accurate human prediction can be. They found that a small number of people they termed "Superforecasters" were able to achieve an impressive level of accuracy, beating that of professional intelligence analysts due to a number of cognitive best practices which included checking statistical base rates, consistently updating their assessments, and questioning their intuitive responses, see, Phillip Tetlock and Dan Gardiner, *Superforecasting: The Art and Science of Prediction*, (New York: Broadway Books, 2015), 90-91, 117, 123, 191-192, 301, 305.

prediction is possible is limited by the time sensitivity of the system to its initial conditions. The ***validity*** of warfare, the causal nature of an environment that will allow decision makers to identify relevant cues to decision-making, still needs to be established. Establishing the validity of warfare as a phenomenon is relevant to establishing how significant a role that intuition can play in decision-making.

Validity in Warfare

The question of the validity of warfare lies in whether there are consistently reliable cues available to decision makers that allow them to understand the situation based on previous experience. Related to the cues is the question of whether it is possible to be successful without having to make a detailed prediction about the future. This is difficult to prove. However, there are number of practices as well as events in military history that demonstrate that warfare is complex, and highly uncertain, but also highly valid, indicating, that there are underlying statistical relationships that make certain courses of action more likely to be successful than others. Such validity in the system indicates there will be cues which an expert decision maker could identify in the environment to use as a clue as to what action to take. Gambling offers a similar relationship where there are good and bad bets to be made based on the situation and one's read of the other players. A decision maker is looking to choose the course of action which offers the highest probability of success. They pull these courses of action from their memory based on experience triggered by cues in the environment. The following discussion will illustrate how organizations and scholars have identified the validity of warfare and attempted to understand and communicate it.

Gary Klein's work with the military, using recognitional decision models, is the primary evidence that warfare is sufficiently valid for the use of intuition.[111] Throughout these studies, Klein and his associates studied command and control and how recognitional decision-making techniques met with success based upon the ability of decision makers to recognize cues in the environment. Klein and Kahneman agree on the validity of the environment of warfare in their joint article, where they both note that it is a highly valid but also a very uncertain environment, similar to poker.[112] It is interesting to note that Clausewitz, too, identified war as being similar to a card game. "In the whole range of human activities, war most closely resembles a game of cards."[113]

A major piece of evidence that warfare is in fact a high validity environment is the use of doctrine by militaries worldwide. Doctrine is a military's best guess at the conduct of operations and reflect good practices from previous operations. This indicates that doctrine captures what seemed to be successful, most of the time, in previous conflicts. The fact that certain principles, tactics, and techniques appeared to be more successful than others is an indication of the underlying statistical probabilities of an engagement between opposing forces. These doctrinal efforts include things like the principles of war, characteristics or fundamentals of offensive and defensive operations, and drills like the hasty attack, relief in place, and withdrawal. These statistical probabilities manifest as the cues required for the development of expertise and intuitive decision-making. Often, doctrine is guilty of being overly deterministic when discussing topics other than the

[111] Gary A. Klein, "Strategies of Decision-making," 56-64; Karol G. Ross, et al., 6-10; John Schmitt, and Gary Klein, "A Recognitional Planning Model."
[112] Kahneman and Klein, 524.
[113] Clausewitz, 86.

underlying nature of war, but this ability to formalize good practices is a significant indicator of validity in warfare.[114]

The Soviet approach to doctrine was highly quantitative. Majors David Fastabend and Vincent Tedesco both wrote on the Soviet approach to quantification in planning while at the US Army's School of Advanced Military Studies. They both noted that the Soviets extensively used military history to quantify their approach to operations, and support tactical decision-making.[115] In this way the Soviets were able to recognize the validity of warfare, and where possible, quantify, and codify it in doctrine. The paper will discuss this approach later in terms of ways to improve CA decision-making.

The Soviets were not the only ones to attempt to codify and quantify interactions in combat. The Lanchester equations for deducing combat results are an example. Trevor Dupuy has also done extensive work in the quantification of tactical factors to create a model he calls the Quantified Judgement Model (QJM). In his words, "this search has been prompted in part by similarities and patterns among military operations in all times and cultures-patterns so clear and consistent that they cannot be ignored."[116] Dupuy's thesis is that combat is determined and that with the appropriate equation, informed by the knowledge of all the relevant factors, and the ability to appropriately quantify these factors, results could be estimated prior to and explained after the fact.[117] There are obvious practical problems with understanding and being able to quantify all the relevant

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[114] The development of the ideas in this paragraph found their genesis in personal correspondence between the author and Dr. Jim Storr.

[115] Major David A. Fastabend, "Fighting by the Numbers: The Role of Quantification in Tactical Decision-making," master's thesis, School of Advanced Military Studies, 1987), 24; Major Vincent J. Tedesco, "Tactical Alchemy: Heavy Division Tactical Maneuver Planning Guides and the Army's Neglect of the Science of War," (master's thesis, School of Advanced Military Studies, 1999), 42-43.

[116] T.N. Dupuy, *Understanding War: History and the Theory of Combat*, (New York: Paragon House Publishers, 1987), xxi.

[117] *Ibid*., xxv-xxvi.

factors prior to battle. Dupuy's work primarily deals with explaining the results of historical battles through the use of his QJM. The argument that combat is determined is not in conflict with complexity as long as it is acknowledged that any attempt to reduce combat to an equation is limited by an observers ability to quantify qualitative factors (like surprise) and that Poincaré's Three Body Problem will persist; the further one attempts to forecast the future the precision required in the measurements will increase exponentially.

More applicable to the concept of validity is Dupuy's Verities of Combat. These are a series of maxims that are derived from his organization's broad study of military history and application of the QJM.[118] These include "flank or rear attack are more likely to succeed than frontal attack," "initiative permits application of preponderant combat power," and "defenders' chances of success are directly proportional to fortification strength." These are examples, similar to doctrine, where the underlying relationships of warfare have been revealed through study which allows for generalizations about what behaviour is more likely to be successful. The Verities of Combat, similar to Principles of War, are a sort of good bet in the game of chance that is warfare. The QJM, while impractical to a practitioner trying to make decisions on operations, has potential as a means of drawing out lessons from history.

There are several implications to the above discussion on complexity and validity. First, since having a complete understanding of the system will be impossible, decision makers must be able to simplify complexity through abstractions or mental models. Both Funke and Storr recognize this requirement in complex interactions. Funke states that

[118] *Ibid*., 1-8.

complex interactions must be reduced to those that are essential.[119] Storr notes that it is the skill of "abstraction or simplification" that is required and that it **can develop through training and education**.[120] Simplification, abstraction, and a focus on the essential aligns with Klein's work on how experts make decisions. Experts create mental models that focus on the critical elements of a situation and then are able to play them out through a series of states which allows them to understand how the situation may evolve.[121] Planning should not bother attempting to gain a perfect understanding, but an understanding that allows decision makers to create a sufficiently valid mental model.

Second, in an environment where planners and decision makers cannot gain a perfect knowledge of the system, optimization will be chimera. Plans need to be good enough to succeed vice optimized. An optimal course of action will be impossible to define and has serious practical disadvantages such as the time it will take to develop it. This was captured nicely by Norman Augustine, former Undersecretary to the US Army, in his XV Law: "the last 10 percent of performance generates one-third the cost and two-thirds of the problems."[122] According to General Desportes of the French Army:

> The decision-maker acts deliberately, using his rationality to establish his modes of action and strategies. However, while the strategies might be rational, three unavoidable constraints mean that their *rationality will always be limited* [author's original emphasis]: the information, which is never complete, the impossibility of envisaging all possible solutions and the inability to analyse these solutions to cover all possible consequences… Thus the decision-maker opts for the least 'unsatisfactory' solution.[123]

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[119] Funke, 683.
[120] Storr, *The Human Face of War*, 53.
[121] Klein, *Sources of Power*, 61-68.
[122] Norman R. Augustine, *Augustine's Laws,* (Reston, VA: American Institute of Aeronautics and Astronautics, 1997), 103.
[123] General Vincent Desportes, *Deciding in the Dark*, translated by Joanna MacDaniel, (Paris: Economica, 2008), 25.

Further, as warfare is adversarial and an adaptive system, as soon as forces act within it the system changes, making what might have been an optimal plan no longer so. The emphasis must be on quick decisions that are good enough to be successful as well as on the ability to adapt to the unforeseen or to the inevitable changes in the situation as a result of friendly and enemy actions.

Lastly, the best way to gain a better understanding of the system is to interact with it. Gaining understanding from standoff will not be possible. As noted in the Cynefin framework, when operating in complex environments, it is necessary to probe the environment to gain a better understanding.[124] Australia has recognized this feature of complexity in the adoption of the concept of Complex Campaigning and the Act-Sense-Decide-Assess (ASDA) cycle which recognizes that forces will need to act prior to sensing to help them better understand the environment.[125] Related to the concept above that optimization isn't possible, the fact that decision makers cannot understand a situation fully before acting clarifies the requirement to avoid trying to optimize a plan, and focus on the ability to plan adaptively. Klein also recognizes this and notes that decision makers should jump to conclusions but be prepared to test them. They should have "strong ideas, weakly held."[126] Warfare does not allow for certainty and decision makers should avoid it. This lack of certainty does not allow for optimization. An adaptable, acceptable solution is what decision makers should aim for in planning efforts.

Conclusion

[124] Snowden and Boone.

[125] Head Modernisation and Strategic Planning, *Adaptive Campaigning 09 – Army's Future Land Operating Concept,* (Canberra: Australian Army Headquarters, 2009), 31-35.

[126] Gary Klein, *Streetlights and Shadows*, 153.

This chapter discussed the nature of war as well as explained it as a complex, unpredictable, yet highly valid system. This high validity provides cues for decision makers which allows for the development of expertise and the use of intuition in decision-making. The implications of the findings of the chapter is that decision makers need to be able to create mental models of the operational environment which are functional abstractions, focused on the critical elements. In this environment, optimization in tactical planning is impossible and not required, since perfect understanding is impossible and a better understanding can only be obtained through interaction with the system. This means decision makers will need to act before having an understanding anywhere near close enough to being able to create optimal plans. Further, as the system will change once the decision-makers act, such an optimal course of action would no longer be optimal anyway. The emphasis, therefore, needs to be on plans that will satisfice and the ability to adapt. Using the material discussed in the last two chapters, the next will look to critique the current CA approach to planning to establish the requirement for change.

CHAPTER 3: PROBLEMS WITH CURRENT PLANNING AND DECISION-MAKING METHODOLOGIES

> *There is, of course, concern regarding the value of trying to impose an orderly process in the midst of a chaotic situation.*
>
> - B-GL-300-003/FP-001 *Command in Land Operations*, on the value of the estimate in the complex environment of war

> *Along the same lines, it is clear that military training in peacetime is, without exception, based on closed systems, in other words, systems that distort the reality of war.*
>
> - General Vincent Desportes

Having established how humans make decisions and the environment in which these decisions must be made the paper now turns to examine the OPP. This chapter will discuss the faults of the OPP in the context of a complex operating environment. These faults include the desire to create and select an optimal course of action (vice aiming simply to satisfice), OPP's simplification of complexity, and the lack of training on intuitive methods of decision-making due to the focus on OPP. Understanding these shortcomings will establish the requirement for change which will be discussed in chapter 4.

The Operational Planning Process

The OPP is a multi-attribute analysis technique for solving problems. It entails five steps: initiation, orientation, courses of action development, plan development, and plan review, with each of these steps entailing several sub steps.[127] It advocates the creation of multiple courses of action, usually three, and then compares them against a set of criteria to determine which is the best to fully develop as a plan for action.[128]

Running parallel to OPP is the Intelligence Preparation of the Operational Environment (IPOE). The intelligence cell runs the IPOE and is meant to support the commander in understanding the impacts of the physical, social, and enemy aspects of the operational environment. Enemy courses of action will be a result of this process. It

[127] Department of National Defence, B-GJ-005-500/FP-000 *The Canadian Forces Operational Planning Process*, (Ottawa: Department of National Defence, 2008), 4-1 – 4-16.

[128] *Ibid*., 4-8 – 4-12.

entails four steps. First, is to define the operational environment. This will propose the organization's area of operations and area of interest to the commander. Second, is to describe the impact of the operational environment. This step is terrain and weather oriented and meant to help the commander and staff visualize how those elements will impact the conduct of operations. Step three is to evaluate the enemy. This step analyses enemy weapons, equipment, organizations, and intent to create templates of potential enemy courses of action. The final step determines enemy courses of action to be wargamed. This stage finalizes the templates created in stage three along with integrating intelligence collection against the proposed potential enemy courses of action.[129] See figure 3.1 below to see how IPOE integrates into OPP and Battle Procedure.

Battle Procedure Model	**Stage of the OPP**	**IPOE Steps**
Plan	1. Initiation	
	2. Orientation	1. Define the Operational Environment 2. Describe the Operational Environment
Prepare	3. Course of Action	3. Evaluate the Threat

[129] Department of National Defence, B-GL-357-001/FP-001 *Intelligence*, (Ottawa: Department of National Defence, 2001), 71-87.

	Development	4. Determine Threat Courses of Action
Execute	4. Plan Development	
Assess	5. Plan Review	

Figure 3.1 – Relationship between Battle Procedure, OPP, and IPOE

Source: Department of National Defence, B-GL-335-001/FP-001 *Decision-making and Planning at the Tactical Level*, 6-3 – 6-6.

The initiation stage begins with the indication that a task is imminent for an organization. This could be the receipt of an explicit order or warning order but could also be other indications or warnings within the operational environment. This stage is primarily oriented towards preparing the planning team for action and concludes with a warning order being produced as well as initial direction for the staff as to the conduct of OPP.[130]

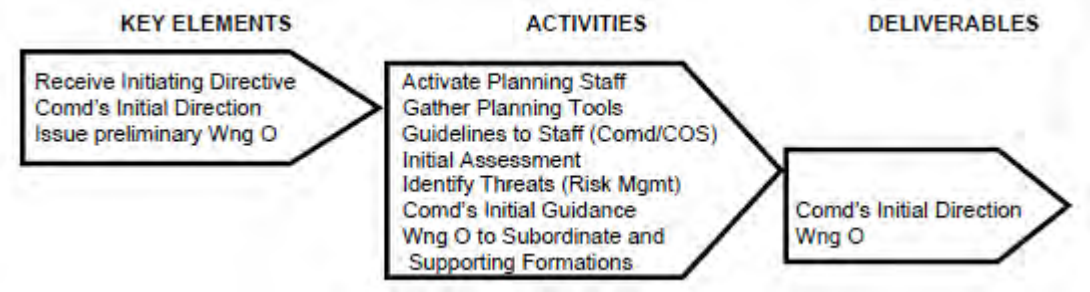

Figure 3.2 – OPP Stage 1 Initiation

Source: Department of National Defence, *The Canadian Armed Forces Operational Planning Process*, 4-2.

The orientation phase is where the command and staff seek to gain an understanding of the situation. It entails mission analysis where the staff analyzes the

[130] Department of National Defence, B-GJ-005-500/FP-000 *The Canadian Forces Operational Planning Process,* 4-2 – 4-3.

intent of higher headquarters in conjunction with explicit and implied tasks and limitations on freedom of action. By looking at other items such as an initial look at friendly and adversary strengths and weaknesses, initial campaign design, an assessment of risk, and timelines, this mission analysis expands on the Army's tactical version.[131] It is also in this step where the intelligence cell begin to integrate its initial IPOE products.[132] This stage concludes with a mission analysis brief to the commander, the commander's planning guidance for course of action development, and an additional warning order.[133]

[131] *Ibid*., 4-4 – 4-7.

[132] Department of National Defence, *The Operational Planning Process Handbook*, (Kingston: The Canadian Land Force Command and Staff College, 2010), 26.

[133] Department of National Defence, B-GJ-005-500/FP-000 *The Canadian Forces Operational Planning Process,* 4-4 – 4-7.

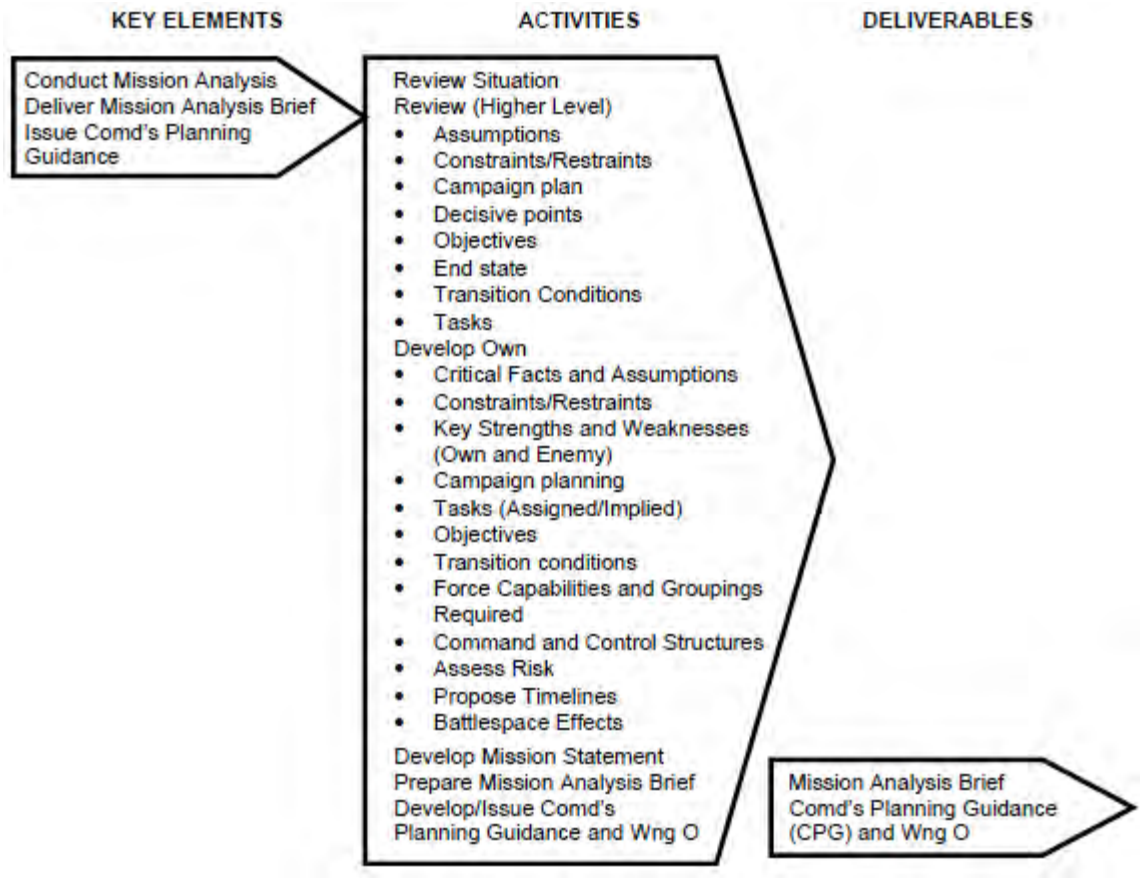

Figure 3.3 – OPP Stage 2 Orientation

Source: Department of National Defence, *The Canadian Armed Forces Operational Planning Process*, 4-4.

The third stage is to develop courses of action in accordance with the guidance given by the commander previously and the analysis done of the organization's mission. The stage begins with an analysis of all the relevant factors, such as opposing and friendly forces, time and space considerations, and logistics. This analysis should result in deduction of relevant tasks, planning guidance, limitations, coordinating instructions, course of action comparison criteria, and other factors that may impact upon operations.[134] The IPOE weighs heavily in this stage for informing the commander and

[134] *Ibid*., 4-8 – 4-12.

staff on the impacts of the environment and adversary. The analysis of the factors is conducted in a rational reductionist method where specific factors are identified and analyzed individually and sequentially. The analysis will lead to a deduction regarding a relevant aspect of the plan such as tasks, coordinating instructions or limitations. There is a division of labour to the analysis as well, with the intelligence cell analyzing the terrain and enemy, operations or plans analyzing friendly factors, and the logistics cell looking at the support factors.

This analysis then allows for the production of enemy courses of action by the intelligence cell and subsequently friendly courses of action by operations or plans. These courses of action are briefed to the commander so that they provide guidance on which courses of action should be carried forward for further development and wargaming. In wargaming the friendly courses of action will be gamed against as many enemy courses of action as is feasible. The wargame will allow the staff to develop a recommendation to the commander as to what is the best course action to carry forward to potentially additional wargaming and for development into a plan. Following the wargame, the staff will present their findings to the commander for their selection of which course of action to carry forward into plan development.[135]

[135] *Ibid*., 4-10 – 4-12.

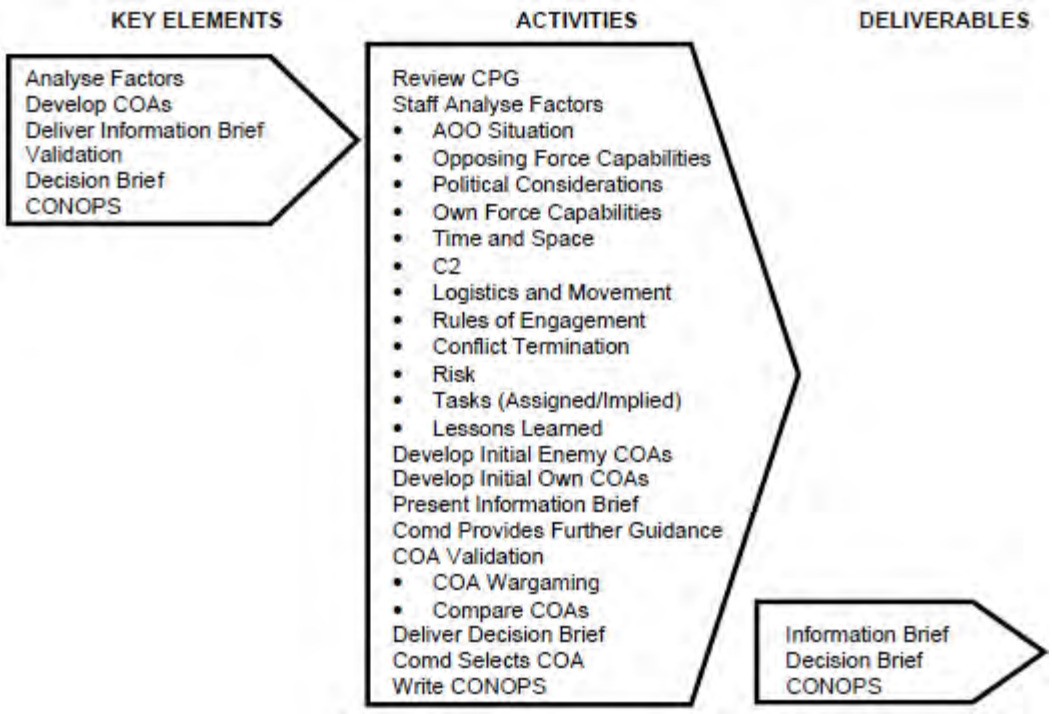

Figure 3.4 – OPP Stage 3 Courses of Action Development

Source: Department of National Defence, *The Canadian Armed Forces Operational Planning Process*, 4-8.

Step four is plan development. In this step the course of action selected is now refined into a complete plan ready for issue to subordinates as well as developing potential branch or sequel plans. At the conclusion of this step the plan will be approved and ready for issue.

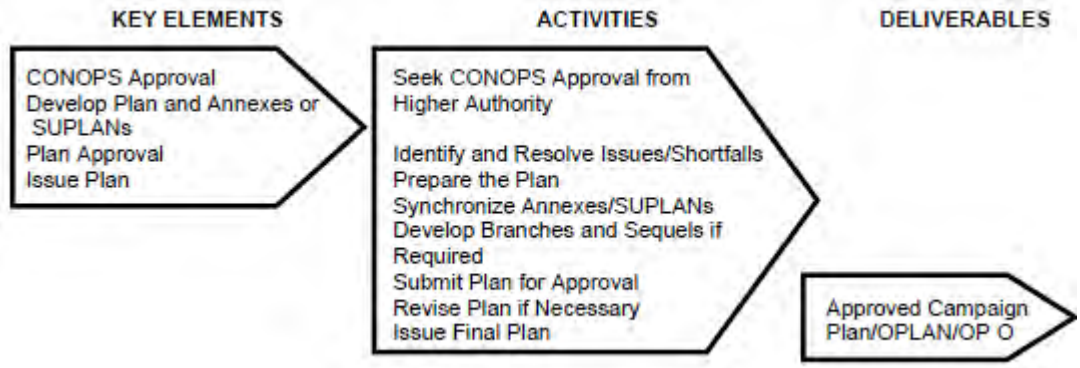

Figure 3.5 – OPP Stage 4 Plan Development

Source: Department of National Defence, *The Canadian Armed Forces Operational Planning Process*, 4-13.

The final stage in OPP is plan review. This stage is meant for plans or contingency plans to ensure their continued viability in a changing environment. This entails conducting a review of ongoing operations to ensure the plan is still valid and periodic reviews of contingency plans to ensure the assumptions they were created under remain valid. The conclusion of this step is an updated, validated, or new approved plan.[136]

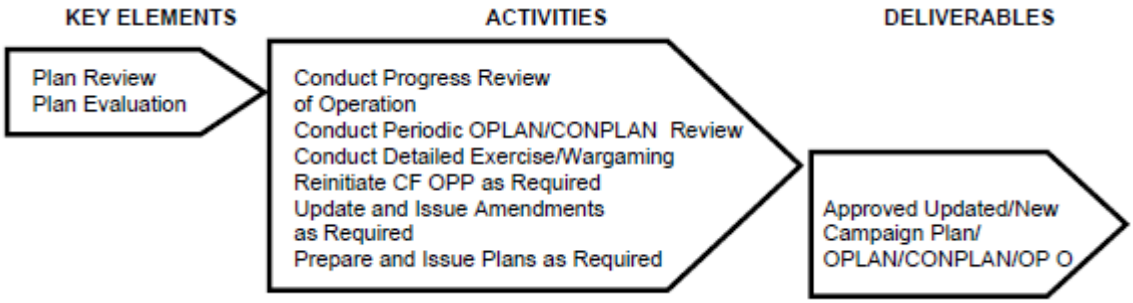

Figure 3.6 – OPP Stage 5 Plan Review

Source: Department of National Defence, *The Canadian Armed Forces Operational Planning Process*, 4-15.

[136] *Ibid*., 4-15 – 4-16.

Linearity and Optimization in the OPP

There are two major observations that can be made based on the review above. The first is that OPP, like all concurrent option comparison models of decision-making, is a problem-solving tool designed to create optimized plans. The analysis of factors, creation of multiple courses of action, and then the comparison of those options demonstrates this. Second is that it is a linear, reductionist model, like other concurrent option comparison models. The analysis of individual factors for deductions and the division of this analysis between different staff functions is evidence of this reductionist approach. Both of these factors need to be examined in greater detail to understand why they are inappropriate for warfare.

An optimization decision strategy is one where decision makers attempt to find the best solution to a problem. This contrasts with a satisficing approach which selects the first approach that works. In this case "working" would mean that the plan will achieve mission success while accounting for limitations placed upon the actor by the headquarters assigning the task. Optimization is much more demanding than satisficing in terms of time and the level of cognitive and staff effort required to conduct the analysis to arrive at an optimal solution.[137]

The optimization strategy is tempting in a tactical environment due to the repercussions of errors measured in casualties, time lost, or mission failure. But a complex, nonlinear environment like combat is impossible to optimize. Without the ability to accurately foresee all the results of the multitude of interactions that can take place within an engagement or battle, in conjunction with the associated impacts of

[137] Klein, *Sources of Power*, 20.

friction on all the actors, optimizing is impossible and threatens paralysis by analysis. Optimization requires a great deal of information, potentially all the information, relevant to a situation, for it to be valid. Obtaining that information against an opponent who is actively working to deny it to the friendly force means that some relevant information will always be missing compromising the optimization. Even in cases where most information is available there will be the question of the reliability of that information and the threat of enemy deception. The problem is multi-faceted in that there are challenges to the quantity, quality, and reliability of information. More practically, Klein recognizes another phenomenon he terms the Zone of Indifference. He states:

> When one option is clearly better than the others, we need not do any analysis. We immediately know what to choose. The closer the options become, the more the strengths and weaknesses are balanced, the harder the choice. The hardest decisions are those that must be made when the options are just about perfectly balanced. Paradoxically, if the options are perfectly balanced it doesn't much matter which one we choose. We agonize the most, spend the most time and effort, making choices that are inside this Zone of Indifference, when we might as well flip a coin.[138]

Problem solving teams often have an intuitive grasp of this fact which can result in the well-known military phenomenon of the "throw away COA (course of action)" where planners create a plan that they know the commander will not select but create it because the process mandates it.[139] Even more pernicious is the modification of selection criteria values when those values result in a recommendation to select a course of action which is not intuitively favoured by the planning team.[140] Ultimately, there is no evidence that the use of multiple alternatives actually results in better decisions; in fact, sometimes it

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[138] Klein, *Streetlights and Shadows*, 86.

[139] Klein, "Strategies of Decision-making," 63.

[140] Klein, *Streetlights and Shadows*, 86; Klein, *Sources of Power,* 299; Thunholm, "Decision-making Under Time Pressure: To Evaluate or Not to Evaluate Three Options Before the Decision is Made?" (unpublished paper, National Defence College and Stockholm University, 2003), 28, https://www.researchgate.net/publication/237281532_Decision_Making_Under_Time_Pressure_To_Evaluate_or_Not_to_Evaluate_Three_Options_Before_The_Decision_is_Made

results in worse.[141] Complexity makes optimization impossible and the Zone of Indifference tells us that in many cases a comparison is not required, either because the choice will be obvious or the value of the choices are so similar that either will achieve the goals in an effective manner.

In the pursuit of optimization one of the major costs is time. War is a time competitive phenomenon. Advantages accrue to the side that can decide faster and decision-making habitually happens in a time compressed environment, therefore, the time required to employ a particular decision-making strategy is a crucial consideration. Canadian doctrine in *Command in Land Operations* has enshrined this time competitive aspect and recognizes two prime factors. The first is that friendly forces should aim to be faster than the enemy to achieve surprise and achieve positions of advantage which will allow for the seizing and retaining of the initiative.[142] Second is the acknowledgement that information is time sensitive. The situation never ceases to change, therefore, with every passing moment the information decreases in value to the decision-maker.[143] Similar to Canadian allies, the Observe, Orient, Decide, and Act (OODA) loop enshrines the dynamic of the decision action cycle.[144]

Jim Storr has commented on the decisive advantage of decision speed in combat. Storr created a simple series of decision tree models where decision makers had varying levels of decision speed and likelihood of making a good decision versus a bad one. In situations where team A had an 80% chance of making a good decision and B a 95%

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[141] Klein, *Streetlight and* Shadow, 23, 85-87; Peter Thunholm, "Decision-making Under Time Pressure," 23-24, 33.

[142] Department of National Defence, B-GL-300-003/FP-001 *Command in Land Operations*, (Ottawa: Department of National Defence, 2007), 1-5.

[143] *Ibid.*, 1-5 – 1-6.

[144] *Ibid.*, 1-13 – 1-14.

chance but made decisions twice as slow, the model gave team A an 80.8% chance of winning versus 3.8% for B and 15.4% for a draw.[145] This dynamic demonstrates the advantage of being able to more quickly understand a situation, decide, and issue direction for action, similar to what is advocated by the OODA loop. The case cited here is an extreme example where team A received two decisions for every one of team B, but, less drastic differences in decision speed would still have an accumulative effect over time and a series of engagements. Decision speed is not to be underestimated in the outcome of engagements and battles.

It takes significantly more time to produce an "optimized" plan than one that satisfices. Further, much of this time is spent on refining courses of action that decision-makers never execute, meaning that there is also an inefficiency aspect to optimizing using multiple courses of action.[146] An additional advantage of selecting a course of action early or only developing a single course is that even if an actor is restrained from taking action after having decided on a plan the team is able to spend their time on reconnaissance, rehearsals, and further refining and making more robust the selected course of action.[147] This robustness includes the wargaming of the plan against a wider array of enemy courses of action and the respective branch and sequel plans that accompany them.

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[145] Storr, *The Human Face of War*, 132-134.

[146] Lieutenant Colonel John J. Antal, "It's Not the Speed of the Computer that Councts! The Case for Rapid Battlefield Decision-making," *Armor*, (May-Jun 1998): 12-13; David J. Bryant, *Concepts for Intuitive and Abbreviated Planning Procedures*, (Toronto ON: Defence Research and Development Canada, 2005), 4; Karol Ross, et al., "The Recognition-Primed Decision Model," 8; Peter Thunholm, "Decision-making Under Time Pressure: To Evaluate or Not to Evaluate Three Options Before the Decision is Made?" (unpublished paper, National Defence College and Stockholm University, 2003), 5, https://www.researchgate.net/publication/237281532_Decision_Making_Under_Time_Pressure_To_Evaluate_or_Not_to_Evaluate_Three_Options_Before_The_Decision_is_Made; Lauder, 43.

[147] Peter Thunholm, "Decision-making Under Time Pressure?", 24.

To a certain extent the practice of OPP acknowledges the challenges discussed above as it places a limit on the number of friendly and enemy courses of action created as well as on how many combinations of those two are war gamed. A truly unfettered concurrent option comparison model would look to create every possible friendly and enemy course of action that was distinguishable, wargame each combination thereof, and then conduct an exhaustive comparison of them all. In examining this problem Major Wilson Shoffner, a student at the US Army's School of Advanced Military Studies, envisioned a situation where a staff created four friendly and five enemy courses of action. That results in twenty possible war games.[148] This is obviously impractical, yet this is what would be required to achieve the optimization criteria which underlies the logic of OPP.

The discussion above illustrates the problem with an optimization approach to decision-making in war. First, it is not possible to optimize in a complex, nonlinear environment. It is unfeasible to have all the relevant information and it is not reasonable to expect all of it to be properly understood in such an environment. Second is the impact of time. Optimization is an expensive proposition in terms of the time and staff effort required to achieve it. A satisficing approach is more efficient. Not only is satisficing more efficient but it can be just as effective. Once one let's go of the idea that increased analysis, and proper comparison criteria can optimize a course of action one understands that satisficing through the use of intuition holds greater promise in its more effective use of time. The paper will now look to the problems of understanding the complexity of the operating environment.

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[148] Major Wilson A. Shoffner, "The Military Decision-making Process: Time for a Change," (master's thesis, School of Advanced Military Studies, 2000), 10.

Understanding Complexity with the OPP

There is a line of thought that the more complex a situation the less appropriate the use of intuition and the more appropriate the use of the OPP and tools like it. The Canadian Army has enshrined this perspective in its doctrine. From *Decision-making and Planning at the Tactical Level*:

> The key determinant as to which approach will be emphasized is based on the amount of time a commander has to make a decision, the complexity of the problem with which they are confronted, and the amount of uncertainty (i.e., quality and quantity of information) surrounding the situation… **This approach [the rational approach] aims to produce the *optimal* solution through methodical analysis and reasoning guided by experience.** It should be used whenever circumstances permit. The rational approach serves especially well in complex or unfamiliar situations as it causes decisions to be made based upon information collected, processed and analyzed.[149]

The quote above demonstrates that the CA has a strong preference for the use of the rational approach to decision-making, not just in complex situations, but at all times. It is interesting to note that the evidence for the use of naturalistic decision-making has existed for several decades yet this approach remains predominant in the CA. This indicates a cultural bias within the institution for this manner of decision-making.

The argument has already been made that optimization is impossible in a complex nonlinear system like war due to a lack sufficient information and/or questions as to its fidelity. Even in a situation, however, where a commander and staff had all the required information and unlimited time, the OPP still would not result in optimal solutions. Firstly, because the inherent complexity of the system does not allow for an optimal solution, but also because the reductionist nature of OPP prevents the understanding of complex systems.

[149] Department of National Defence, *Decision-making and Planning at the Tactical Level,* 1-1.

A reductionist approach sees individual elements of a system being analyzed to understand how it works. This approach works under the assumption that the aggregate understanding of all the subsystems of a complex system will lead to understanding of the system as a whole.[150] We see this approach in OPP during the orientation phase when each element is analyzed individually for relevant deductions. This analysis is also divided amongst the staff branches for the sake of efficiency. This approach is, however, misguided when it comes to understanding complexity.

A complex system is more than the sum of its parts and there is more learned from the connections between the various elements than from each component.[151] This means that the standard method of dividing a problem amongst experts and examining the various pieces to come to an understanding of the overall operation will not be effective.[152] In the words of Nassim Taleb:

> Categorizing always produces reduction in true complexity. It is a manifestation of the Black Swan generator… Any reduction of the world around us can have explosive consequences since it rules out some sources of uncertainty; it drives us to a misunderstanding of the fabric of the world.[153]

The US Army has officially recognized this fact. In its 2015 publication on the Army's approach to design the introduction states:

> Design thinking in Army doctrine resulted from a recognition that commanders and staffs had difficulty understanding complex situations. This hindered their ability to distinguish between symptoms of problems and their root causes. This

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[150] Tom Czerwinski, *Coping with the Bounds: Speculations in Non Linearity in Military Affairs,* (Washington D.C.: Command and Control Research Program, 1998), 8.

[151] *Ibid.*, 9-10.

[152] Dr David J. Bryant et al., 30; Mulloy, "Penetrate Uncertainty: Descriptive Planning in a Complex Tactical Environment,"; Ben Zweibelson, "'The Enemy Has a Vote' and Other Dangers in Military Sense-Making," *Journal of Military Operations* 2 No 2, (Spring 2014), 22, https://www.tjomo.com/article/39/The_Enemy_has_a_Vote_and_Other_Dangers_in_Military_SenseMaking/; Taleb, 16; Tom Czerwinski, 1-10.

[153] Taleb, 16.

> difficulty led to solutions that addressed symptoms of problems rather than problem causes.[154]

The publication is clearly tied to the difficulties experienced by the US Army, and other western forces, in Afghanistan and Iraq. The CAF's Joint Command and Staff Program has recognized the difficulty of complex problems and has introduced instruction in design in recent years for both the main planning curriculum as well as for the Advanced Joint Warfighting Stream. Dr William Duggan, a teacher at Columbia's Business school, writing on behalf of the Strategic Studies Institute has looked at this issue of when one should plan using intuitive and analytical methods. He argues that an intuitive approach is more appropriate for complex situations.

> In practice, problems amenable to analysis versus intuition are the opposite of what FM 5-0 tells us. The seven-step analysis model works not for complex problems, but for simple ones, where you know the criteria and you can generate solutions easily – like wash rack costs and locations. Intuition – or at least, strategic intuition as we present it here – works best not for simple problems but for complex ones, where you do not know the criteria beforehand, and it is hard to generate any possible solution at all.[155]

Klein makes a similar argument:

> The claim that successful decision makers rely on logic and statistics instead of intuition matters because systematic analysis may work for well-ordered tasks. But it runs into difficulty in complex settings, and it leads to overthinking. We can make very poor decisions when we rely solely on systematic analysis.[156]

Referring back to the Cynefin framework Duggan and Klein allude to simple or complicated problems, vice complex ones, are amenable to the quantification and prediction that analytical models call for.

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[154] Department of the Army, ATP 5-0.1 *Army Design Methodology*, (Washington D.C.: Headquarters Department of the Army, 2015), v.

[155] William Duggan, *Coup d'Ooeil: Strategic Intuition in Army Planning*, (Carlisle, PA: Strategic Studies Institute, 2005), 16.

[156] Klein, *Streetlights and Shadows*, 82.

The problem of analysis in complexity is due to the inability to accurately account for the workings of cause and effect, but also due to the sheer quantity of information that is required to make an optimal decision. The digitization of the battlefield in conjunction with the significant bandwidth available on operations have exacerbated this problem.[157] Humans ability to conduct analytical problem solving with significant quantities of information is limited. The numerous heuristics and biases described by Kahneman are examples of this. Nassim Taleb describes a study where subjects observed a series of blurry exposures to the image of a fire hydrant. One group saw the resolution improved over a series of ten images and the other five. The group that saw fewer images identified it as a fire hydrant quicker. According to Taleb this is an example of how humans can be easily distracted by details and miss the larger phenomenon, especially if the details are sensational.[158] Klein cites a study by Dutch decision researcher Ap Dijksterhuis where it was found over a series of studies that intuitive decision-making performed better than an analytical approach. One study asked subjects to select a car based on it having the best combination of positive features as defined by the experiment. One group had to make the decision using only four attributes, in another, 12. Some had the time to deliberate, while another task distracted others just prior to their choice. Those given all the time to deliberate made the right choice in the simple model of only four factors, while those distracted and forced to use their intuition chose the right option in the deliberate and distracted case.[159]

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[157] Maj Demetrios J. Nicholson, "'Seeing the Other Side of the Hill': The Art of Battle Command, Decisionmaking, Uncertainty, and the Information Superiority Complex," *Military Review,* (November-Decemeber 2005): 61.

[158] Taleb, 144.

[159] Klein, *Streetlights and Shadows*, 76.

Analytical approaches to problem solving underestimate the limitations of human rationality and the power of intuition. Leveraging intuition is essential to maximize human decision-making, and prevent it from being overwhelmed, especially in complex environments. Naturally, the CA's preference for analytical decision-making, as manifested in the OPP, impacts how the CA trains its leaders, which this paper will now examine.

Training to Plan in the CA

Since the CA only recognizes analytical decision-making processes, training focuses on the execution of these procedures. The fact that analytical processes are easier to instruct and evaluate versus less structured approaches or pure expertise in the execution of planning reinforces this tendency. This focus on the execution of procedures limits the development of true expertise and the development of intuition.

Intuition, of course, is not limited to recognitional decision-making. There are numerous parts of the OPP that require the use of intuition. Doctrine and research recognize the requirement for the use of intuition in OPP.[160] The leap from mission and factors analysis to course of action development requires some level of synthesis that will be recognitional in nature. There is no analytical process that precedes the selection of course of action comparison criteria. It is simply perceived that certain fundamentals, principles, or factors will be more important than others on a mission. Those fundamentals and principles receive various weightings to represent their importance amongst the selected criteria. This is another example of the use of intuition. Similarly, as

[160] Department of National Defence, *Command in Land Operations*, 2-14 – 2-16; Department of National Defence, *Decision-making and Planning at the Tactical Level*, 1-1; Bryant, et al., 33; Duggan, 10-11.

discussed above, intuition is critical to dealing with the vast quantities of information available to modern commanders and staff.[161] As the quantities of information available continues to increase, commanders and staffs will need to be able to better discriminate between what is important and what is not. Intuition is critical in making these differentiations. Commanders and staff require training designed to prepare them to make the best intuitive decisions even within the context of OPP.

Some may argue that running through cycles of OPP would provide the experience required to develop the expertise for recognitional decision-making, however, the evidence indicates otherwise. It is exposure to numerous situations that allows decision-makers to begin to build expertise and understand the underlying causal relationships and recognize elements of similarity between cases. This expertise also allows for the mental imaging discussed earlier. According to Klein, "we do not make someone an expert through training in formal methods of analysis. Quite the contrary is true, in fact: we run the risk of slowing the development of skills."[162] Dr. Gerry Duggan concurs with the views of Klein, "making them use the four steps of analytic decisionmaking only retards their development and does not help them make better decisions in the first place."[163] The execution of procedures removes the emphasis from the actual decision itself as well as from the understanding of the situation that allows for intuitive decisions to be made. Further, the development of expertise involves a component of repetition. The laborious procedures of OPP and other similar methods prevent a repetitious approach from being taken. A purely analytical approach to training for decision-making is hamstringing the CA from fully unleashing the talent resident in

[161] Nicholson, 61.
[162] Klein, *Sources of Power*, 30.
[163] Duggan, 9.

its leadership by building the expertise required for rapid intuitive decisions at all levels of war. Such an approach threatens to make experts at the process of decision-making vice decision-making itself. This theme will be further examined in the final chapter.

The CA's preference for analytical decision-making limits officers from gaining expertise for rapid intuitive decision-making. This limits their effectiveness when using OPP as well. A different approach to training is required to increase expertise and better prepare officers for decision-making.

Conclusion

This chapter has argued that the OPP and the way the CA trains for decision-making needs improvement. The OPP utilizes an optimization strategy which is inappropriate for war. A satisficing methodology embodied in naturalistic decision-making approaches would be better. OPP also experiences difficulties with dealing with complexity due to its reductionist approach. The division of labour between the staff sections when doing factors analysis, in conjunction with examining factors in isolation from others reduces the level of understanding of the operating environment that could be possible with a more holistic analysis. Lastly, the training implications of the CA preferencing analytical decision-making was discussed. This preference privileges the conduct of the OPP which prevents the development of expertise at decision-making itself. The final section of the paper will discuss the implications of this chapter along with recommendations for how the CA can improve decision-making and planning.

CHAPTER 4: RECOMMENDATIONS

> *No plan of operations extends with any certainty beyond the first contact with the main hostile force.*
>
> - Helmuth von Moltke, the Elder

> *We cannot truly plan, because we do not understand the future-but this is not necessarily bad news. We could plan* while bearing in mind such limitations*. It just takes guts.*

- Nassim Nicholas Taleb

Based on the arguments in the previous discussion, this chapter will make recommendations to amend the way the CA approaches planning and training soldiers to plan. It will begin with a discussion of planning processes, what they achieve and how the CA could improve. The chapter will argue for the use of a version of Klein's Recognitional Planning Model (RPM) and design, along with an argument for where OPP now fits within the planning continuum. The paper will then turn to how training needs to change to improve CA planner's ability to operate in complexity. Lastly, the burgeoning field of artificial intelligence will also be examined to determine its use in planning and how the CA must prepare itself to leverage this emerging technology.

The Purposes of Planning

What is it that planning achieves? When we consider Moltke the Elder's statement from above (more commonly translated in the CA as "no plan survives first contact") one could make the argument that planning is a pointless endeavor. As Taleb notes in the epigraph, this is not the case: decision-makers simply must plan with an understanding of human limitations in understanding complexity and foresight.

A common understanding of what planning achieves is that it is a basis for adaptation and learning. While the plan cannot fully anticipate everything the enemy will do, it provides the foundation for deviation.[164] This adaptability develops as the plan brings the commander, staff, and subordinates to a similar understanding of the situation and the relationships between friendly elements. Planning, therefore, is a learning process

[164] Antal, 16.

that is less about dictating what exactly will happen but coming to better understand the operational environment and establishing relationships between forces and objectives.[165]

Major Cole Petersen, writing at the United States Marine Corps' staff college, examined planning in the 1st Marine Division (1 MARDIV), commanded by General Mattis, prior to and during the conventional phase of the second invasion of Iraq. He conducted extensive primary source research with interviews of key staff of 1 MARDIV and made several findings which are applicable to planning in general. One of these findings is that planning is not meant to predict the future and come up with a detailed plan to respond to the envisioned conditions. Instead, planning anticipates potential future conditions along a spectrum of probabilities, implying that detailed planning is misguided and planners should instead focus on establishing an end state and then steadily assessing "the situation and overcome impediments to closing the gap between current and envisioned conditions."[166]

Maj Petersen also found in his interviews with the 1 MARDIV chief planner that value was found not in building the specific plan for the invasion but the act of planning itself. It was the planning which elevated the situational awareness of the entire staff as to what would be necessary from the various elements of the force to achieve success and to be adaptable in the face of the unexpected.[167] Knowing this, one can understand what Dwight Eisenhower meant when he said, "plans are worthless, but planning is everything."[168] Echoing the research by Per Bak and Kan Chen on the predictability of

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[165] Major John Garrett, "Plans That Survive First Contact," unpublished paper, School of Advanced Military Studies, 2000, 36; Department of the Navy, MCDP 5 *Planning*, (Washington, D.C.: Headquarters United States Marine Corps, 1997), 4-5.

[166] Petersen, 3.

[167] *Ibid.*, 11.

[168] Department of National Defence, *Decision-making and Planning at the Tactical* Level,1-6.

sand piles being bounded by time, General Mattis acknowledged that there would be a requirement to make many decisions as exact conditions were unpredictable, however, he wanted the first 96 hours planned in greater detail as the conditions were more predictable.[169] Finally, prior to the invasion and during the conduct of operations, there was little if any generation of multiple courses of action. Instead, Mattis would develop a course of action and have his staff conduct an analysis to refine its details and understand the risks and requirements for the proposed course of action.[170] This approach aligns with that proposed by Klein and his RPM.

Major John Garrett's paper from his time as a student at the School of Advanced Military Studies addressed this question of just what planning achieves by examining operation orders from the US 9th Infantry Division in Normandy in 1944. He made several critical findings. First, he found a trend where at the beginning of hostilities orders were long and prescriptive; the more experience in combat a unit gained, the shorter the orders became. They aim only to give direction for the immediate future, they are kept simple, and they do not attempt to predict what the enemy might do.[171] There was no use of enemy most likely and most dangerous course of action.[172] Second, was that "the only thing a unit required from the order was the relationship to higher and adjacent units, in the form of task-purpose mission statements and control measures."[173] Much of the planning effort went into things that were unlikely to change, such as terrain factors, such as what would be the best point at which to cross a river, or things that were in the control of friendly forces such as an appropriate task organization that would allow

[169] Petersen, 12.
[170] *Ibid*., 29.
[171] *Ibid*., 3.
[172] *Ibid*., 9.
[173] *Ibid*., 10.

subordinates to achieve assigned tasks.[174] This meant that planners did not overly bother fretting about what the enemy would do and focused on what they could control.

The concept of planning for what commanders and staffs can control was common elsewhere in Normandy. Lieutenant-General Sir Frederick Morgan was Chief of Staff Supreme Allied Command (COSSAC) prior to the appointment of General Eisenhower as Supreme Allied Commander and was responsible for much of the planning for operation OVERLORD, the invasion of France. In planning for the landings the primary considerations were terrain, specifically which beaches were suitable, and the time required to build up forces.[175] As opposed to trying to gain a detailed understanding of what the enemy would do, analysis focused on the knowable. The question of the build up was the most difficult to address due to its relevance being based on just what the forces ashore would face from the enemy. Specifically, how long would it take the Germans to counterattack and with forces in what strength. This problem is, however, complex, and hence unpredictable. To determine when, and by what, Allied forces would be counter attacked, planners would have needed to know the strengths of enemy reserves, along with the time for warning, marshalling, and movement the required distance.[176] This, however, is the portion that can actually be reasonably determined. The other remaining portions of the estimate would be how effective would be Allied deception measures, air interdiction, and the French underground in delaying the arrival

[174] *Ibid*., 29.

[175] Lieutenant-General Sir Frederick Morgan, *Overture to Overlord*, (London: Hodder & Stoughton Limited, 1950), 152, 161-162.

[176] *Ibid*., 161.

of German reserves to the critical place and time.[177] Morgan acknowledges the impossibility of such a calculation, but offered the following.

> Summing it all up, the only way in which to arrive at anything that meant anything seemed to be to turn the whole thing round and to try to figure out the maximum German resistance against which we reckoned we should still be able to make headway to the extent and at the speed desired. From this angle we arrived at an answer as follows. We could make our plan work if on D-day there were not more than a total of twelve German full-strength mobile field divisions in reserve in France. Of these there must not be within striking distance of Caen more than three on D-day, more than five on D plus 2 Day or more than nine on D plus 8 Day. Beyond that point we reckoned we should be over the hump. There was the answer for what it was worth.[178]

This analysis reveals the complexity of trying to understand enemy actions ahead of time, and the impossibility of trying to make detailed plans to counter their foreseen actions. By looking at geographical, time, space, and friendly force factors, planners are able to make deductions that are more likely to be accurate while gaining an understanding of what potential enemy actions their plans can withstand.

This paper has used several historical examples to illustrate what is possible with intuition as well as what constitutes good planning. The most recent professional thought coincides with these findings. The recently released Canadian Joint Operations Command Pan Domain Force Employment Concept also recognizes the utility of satisficing approaches to planning. "Increasing tempo calls for institutional agility. The CAF must embrace satisficing strategies so that it can outpace adversary decision-action cycles. This will require a re-thinking of risk trade-offs like perceived certainty versus speed."[179] The requirement for such an approach to planning is not limited to a historical context.

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[177] *Ibid*., 162.
[178] *Ibid*.
[179] Canadian Joint Operations Command, *Pan Domain Force Employment Concept Prevailing in an Uncertain World*, (Ottawa: Department of National Defence, 2020), 26.

Experience on contemporary operations and predictions regarding future requirements indicate a continued necessity for a satisficing approach to planning.

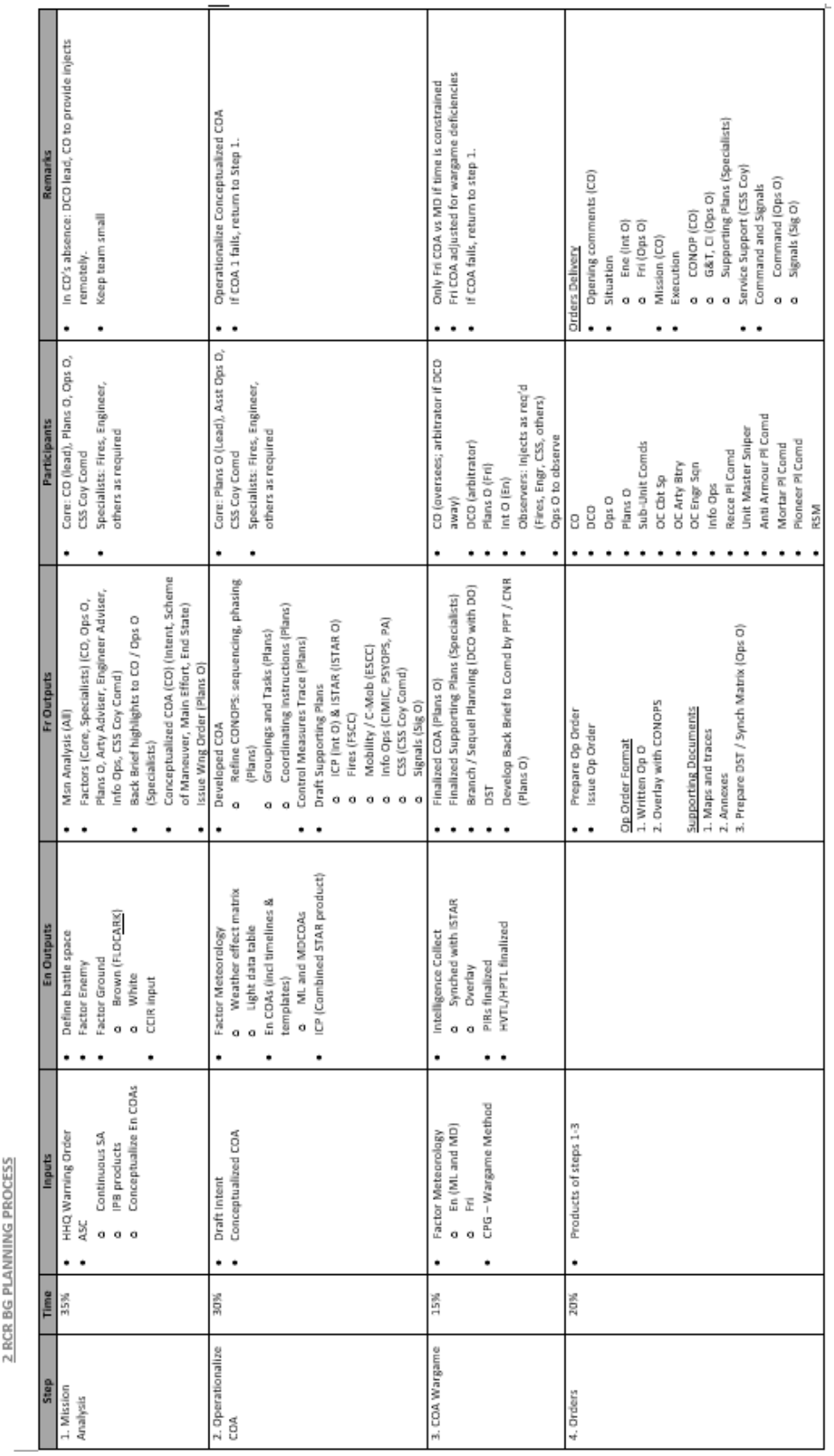
The above discussion displays what characterizes good planning in combat. Much of the analysis should focus on what can realistically be known. Planning need not lead to the creation of a plan that exactly charts the path forward well into the future. In fact, complexity prevents it from doing so. Optimization, the goal of OPP, is therefore an impossibility. Planning, in fact, enables the commander and staff to gain a greater appreciation for the operating environment. This appreciation allows for a better ability to adapt to the inevitable surprises the enemy and other elements of the environment will present. The course of action produced by the process will provide the foundation for that adaptation by establishing end states, objectives, and relationships between various units. Focusing analysis on enemy capabilities, as opposed to specific courses of action, the terrain, friendly forces, and time, space, and force considerations, will allow for an understanding of factors less liable to change than others. As combat is a complex system, all analysis should be bounded in time, acknowledging that the further in the future analysis is made, the less accurate it will be. With an understanding of what planning can achieve, the OPP is ill suited to planning in combat. The paper will now look at an alternate planning process to the OPP.

A Recognition and Metacognitive Planning Model

Any alternative to the OPP must leverage the use of intuition to maximize speed of decision-making. The requirement has already been identified by the field force with

several units employing planning processes other than the OPP and the estimate.[180] Klein's RPM, discussed in chapter 1, is the most prevalent model, with units in the CA already having further operationalized it. The format used by 2nd battalion, The Royal Canadian Regiment (2 RCR), which is identical to that used by other CA units is in figure 4.1 and has several advantages.

[180] 2 RCR used a system similar to Klein's RPM throughout their high readiness training in 2016 and 2017 to include Ex UNIFIED RESOLVE I and II and Ex MAPLE RESOLVE. This process came out of 2nd battalion, Princess Patricia's Canadian Light Infantry (2 PPCLI). During the same period 1 RCR employed the British Seven Questions process. The author was a member of 2 RCR during the period in question and the process was seen as effective in leveraging the experience of the Commanding Officer and making rapid decisions.



2 RCR BG PLANNING PROCESS

Step	Time	Inputs	En Outputs	Fr Outputs	Participants	Remarks

1. Mission Analysis	35%	• HHQ Warning Order
		• ASC
		  ▫ Continuous SA
		  ▫ IPB products
		  ▫ Conceptualize En COAs
			• Define battle space
			• Factor Enemy
			• Factor Ground
			  ▫ Brown (FLOCARK)
			  ▫ White
			• CCIR input
				• Msn Analysis (All)
				• Factors (Core, Specialists) (CO, Ops O, Plans O, Arty Adviser, Engineer Adviser, Info Ops, CSS Coy Comd)
				• Back Brief highlights to CO / Ops O (Specialists)
				• Conceptualized COA (CO) (Intent, Scheme of Maneuver, Main Effort, End State)
				• Issue Wng Order (Plans O)
					• Core: CO (lead), Plans O, Ops O, CSS Coy Comd
					• Specialists: Fires, Engineer, others as required
						• In CO's absence: DCO lead, CO to provide injects remotely.
						• Keep team small

2. Operationalize COA	30%	• Draft Intent
		• Conceptualized COA
			• Factor Meteorology
			  ▫ Weather effect matrix
			  ▫ Light data table
			• En COAs (incl timelines & templates)
			  ▫ ML and MDCOAs
			• ICP (Combined STAR product)
				• Developed COA
				  ▫ Refine CONOPS: sequencing, phasing (Plans)
				  ▫ Groupings and Tasks (Plans)
				  ▫ Coordinating Instructions (Plans)
				• Control Measures Trace (Plans)
				• Draft Supporting Plans
				  ▫ ICP (Int O) & ISTAR (ISTAR O)
				  ▫ Fires (FSCC)
				  ▫ Mobility / C-Mob (ESCC)
				  ▫ Info Ops (CIMIC, PSYOPS, PA)
				  ▫ CSS (CSS Coy Comd)
				  ▫ Signals (Sig O)
					• Core: Plans O (Lead), Asst Ops O, CSS Coy Comd
					• Specialists: Fires, Engineer, others as required
						• Operationalize Conceptualized COA
						• If COA 1 fails, return to Step 1.

3. COA Wargame	15%	• Factor Meteorology
		  ▫ En (ML and MD)
		  ▫ Fri
		• CPG – Wargame Method
			• Intelligence Collect
			  ▫ Synched with ISTAR
			  ▫ Overlay
			• PIRs finalized
			• HVTL/HPTL finalized
				• Finalized COA (Plans O)
				• Finalized Supporting Plans (Specialists)
				• Branch / Sequel Planning (DCO with DO)
				• DST
				• Develop Back Brief to Comd by PPT / CNR (Plans O)
					• CO (oversees; arbitrator if DCO away)
					• DCO (arbitrator)
					• Plans O (Fri)
					• Int O (En)
					• Observers: injects as req'd (Fires, Engr, CSS, others)
					• Ops O to observe
						• Only Fri COA vs MD if time is constrained
						• Fri COA adjusted for wargame deficiencies
						• If COA fails, return to step 1.

4. Orders	20%	• Products of steps 1-3		• Prepare Op Order
				• Issue Op Order
				
				Op Order Format
				1. Written Op O
				2. Overlay with CONOPS
				
				Supporting Documents
				1. Maps and traces
				2. Annexes
				3. Prepare DST / Synch Matrix (Ops O)
					• CO
					• DCO
					• Ops O
					• Plans O
					• Sub-Unit Comds
					• OC Cbt Sp
					• OC Arty Btry
					• OC Engr Sqn
					• Info Ops
					• Recce Pl Comd
					• Unit Master Sniper
					• Anti Armour Pl Comd
					• Mortar Pl Comd
					• Pioneer Pl Comd
					• RSM
						Orders Delivery
						• Opening comments (CO)
						• Situation
						  ▫ Ene (Int O)
						  ▫ Fri (Ops O)
						• Mission (CO)
						• Execution
						  ▫ CONOP (CO)
						  ▫ G&T, CI (Ops O)
						  ▫ Supporting Plans (Specialists)
						• Service Support (CSS Coy)
						• Command and Signals
						  ▫ Command (Ops O)
						  ▫ Signals (Sig O)

Figure 4.1 – RPM Process Further Operationalized by 2 RCR and Other CA Units

The uncertainty and complexity of war makes creating optimal solutions impossible. Further, the time competitive nature of operations means that acting more quickly than one's adversary is highly advantageous. The planning model recognizes this by leveraging the expertise of the Commanding Officer (CO) to select a single course of action early in the planning process. As the most highly trained and experienced member of the battalion, the CO, enabled by his staff, should be able to quickly understand a solution that would be workable and to get the staff operationalizing the course of action. This prevents the staff from creating numerous other courses of action that will never be executed, in the name of developing an optimal plan.

Importantly, more rapid decision-making will also allow for more rapid adaptation. Error is inevitable in the complex environment of warfare and adaptation will be critical. Those who can most rapidly adapt will gain a competitive advantage. The United States Marine Corps explicitly identifies the linkage between planning and adaptation in its Marine Corps Doctrinal Publication 5 *Planning*. It sees planning as a form of "*anticipatory adaptation*" [original emphasis].[181] It notes that when the situation requires a change from the original plan, "we adjust from an existing scheme based on a common understanding of the situation and the expected results."[182] Therefore, the CA should seek a process that facilitates the making of many rapid decisions. Similar to that proposed by the Australian Army's ASDA loop, units should seek to act, sense the changes in the operational environment due to the interactions between themselves, the adversary, and the environment, decide upon what adaptations need to be made, and then

[181] Department of the Navy, MCDP 5 *Planning*, (Washington, D.C.: Headquarters Marine Corps, 1997), 14.

[182] *Ibid.*

to implement those adaptations as quickly as possible.[183] Intuition and the RPM enable such a process.

The RPM is a proven planning technique. It has been used successfully by units executing the CA's most demanding training exercises as well as been trialed by operational researchers with trained staffs. Karol Ross, Gary Klein, Peter Thunholm and others trialed the model at Fort Leavenworth's Battle Command Battle Laboratory in 2003 with an ad hoc brigade staff over a period of two weeks. The staff received two days of training on RPM to ensure familiarity and then conducted a series of planning iterations.[184] The process had significant face validity with the staff and they estimated that it allowed them to plan approximately 30% faster than with the Military Decision-making Process (MDMP), the US equivalent of the OPP.[185]

Similar results have been found by Peter Thunholm's independent research. Using a process comparable to RPM, known as the Planning Under Time-pressure (PUT) model, positive results were found for the use of a single course of action approach to decision-making. In his study, candidates on the Swedish Army's Staff Officers Program received a tactical problem of a division in the defence. The candidates divided in two with one set using the Swedish Army Regulations Decision Model, which is a concurrent option comparison model and the other using the PUT model.[186] The study then measured decision quality as assessed by a board of subject matter experts, decision speed, and the usability of the model. It was found that those using the PUT model made mildly better

[183] Head Modernisation and Strategic Planning, 31-35.
[184] Karol G. Ross, et al. "The Recognition Primed Decision Model," *Military Review*, (July-August 2004): 8.
[185] *Ibid.*
[186] Thunholm, "Decision-making Under Time Pressure," 13-14.

decisions.[187] Interestingly, about 15% of those who used the multiple option model actually rejected a course of action assessed as being of higher quality.[188] This could imply that the decision-makers had a bias or lacked the expertise to select the best option from their generated courses of action, or that there is something in the process itself that hinders the selection of the most appropriate course. Those using the multi option model required 17% longer to select a course of action, and interestingly, 15% of these subjects admitted that they had in fact decided on their course of action during step two when they should still be analyzing factors.[189] Further, after reviewing the self-reports from the participants it was found that the majority made mental commitment prior to the appropriate step, in both the single and multiple option models.[190] The finding that the majority of subjects made the decision early in the process speaks to the strength of intuitive models of decision-making. Type 1 thinking drives us to jump to conclusions. The concept that decision makers will conduct an exhaustive factors analysis without formulating a course action is unrealistic. Intuitive approaches harness this fact with expertise to achieve good decisions faster. Related to the first finding, is the fact that once a decision-maker committed to a particular course "subsequent information was distorted in favor of the preferred alternative."[191] This speaks to the common experience of the "throw away COA," when staffs know they have a workable option but develop others simply to satisfy the requirements of the process, as well as the modification of selection criteria weighting to select the intuitively preferred course of action. Lastly, those using the multiple course approach perceived the model as significantly less applicable to the

[187] *Ibid.*, 23.
[188] *Ibid.,* 24.
[189] *Ibid.*, 24-25.
[190] *Ibid.*, 28.
[191] *Ibid.*

requirements of actual operations than those who used the single course approach.[192] Considering the increased speed of decision-making and the tendency to jump to a conclusion, this finding should not be surprising. Having said this, planners should see the decision model as valid as they must put it to work on operations and is, therefore, a legitimate metric for the value of a model. Thunberg has achieved similar result in another study using another cohort of students at the Staff Officers Program.[193] Thunberg summarizes it thusly,

> A growing body of naturalistic decision-making research has indicated that maximization strategies are rarely used among professionals. The studies by Payne et al. (1993) and Johnston et al. (1997) also indicate the shortcomings of a maximization strategy already under moderate time pressure. These two circumstances in addition to the findings of this study suggest that the maximization strategy might have serious limitations as a tool for decision-making in many naturalistic settings, and it should not be taught by large organizations such as the military as a "model for all decision-problems (Swedish Army, 1995, p. 183).[194]

The RPM or other recognitional models like PUT are well supported doctrinally. As noted in chapter three, *Command in Land Operations* acknowledges the role that intuition plays in decision-making and the time sensitive nature of warfare.[195] *Decision-making and Planning at the Tactical Level* explicitly states a preference for analytical decision-making approaches but also recognizes the importance of rapid decisions, going as far to say "tempo will demand a less than perfectly-informed decision."[196] This means that the CA has some of the intellectual framework in place to accept the RPM. Further

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[192] *Ibid.*, 25-26.

[193] Peter Thunberg, "Military Planning and Decision-making Under Time-pressure: A Scenario Based Experimental Comparison Between Two Models," (unpublished paper, Swedish Defence University), 30-32.

[194] Thunberg. "Decision-making Under Time Pressure: To Evaluate or Not to Evaluate Three Options Before the Decision is Made?", 33.

[195] Department of National Defence, *Command in Land Operations,* 1-13 – 1-14, 2-14 – 2-16.

[196] Department of National Defence, *Decision-making and Planning at the Tactical Level*, 1-1, 1-4.

support comes from the United States Marine Corps' MCDP 5 *Planning* which sees planning as a learning process, and a means for adaptation, which must balance against the fact that the further a planner forecasts into the future, the less accurate their estimates will be.[197]

This approach will not result in optimality, however, as discussed earlier, optimality is impossible to define, let alone actually achieve. Despite this, some might reserve opposition to RPM and its ilk due to the perceived arbitrariness of relying on the experience of a commander and staff to determine a course of action without reference to any other potential options. Referring back to the multitude of heuristics and biases that Type 1 thinking is vulnerable to, such criticisms are not wholly without merit. There are, however, numerous responses to such opposition.

No problem-solving strategy, including OPP, is invulnerable to the impacts that the inexperience or unfamiliarity of a commander and their staff could bring to an operation.[198] As discussed above, creating multiple courses of action does not guarantee a better solution. It is possible that an inexperienced commander and staff, could develop three inappropriate courses. RPM attempts to limit the impact of this potentiality by focusing on the initial understanding of the situation, the mission analysis, that should enable the commander to visualize an option that will satisfice.[199] In this way, RPM leverages a commander and staff's experience by allowing for the use of intuition to identify a course of action early in the process, however, this is subject to an initial mission analysis to understand what to accomplish, and then further factors analysis once

[197] Department of the Navy, *Planning*, 4-5, 13-16, 20.
[198] Karol G. Ross, et al., 8.
[199] Klein, "Strategies of Decision-making," 59; Thunholm, "Decision-making Under Time Pressure: To Evaluate or Not to Evaluate Three Options Before the Decision is Made?," 34.

the course has been selected. In this way RPM ensures the mission is well understood, allowing for an intuitional solution to be envisioned, and seeks to exploit the advantages of both System 1 and 2 thought processes. Practically, a focus on a shorter planning timeline, with an understanding that the plan will merely satisfice vice optimize, will make staffs more likely to be willing to change their plans and adapt in the face of the unsuspected. There are other techniques that can augment the RPM process to further improve its results and insulate it from the potential dangers of intuition.

Taming Intuitive Decisions

The first technique would be to integrate elements of the PUT model into the RPM. While the PUT model is a single course of action model similar to RPM, it does advocate a brainstorming process where planners depict all potential solutions that "come to mind" graphically.[200] These solutions are not developed into courses of action. They are simply depicted as a potential option and then the decision-maker chooses a single one to go forward into development. Thunholm cites evidence that multiple option generation (not to be confused with the complete development of options into courses of action) can in some cases lead to superior decisions and often appear towards the end of option generation.[201] One can envision a situation where after a mission analysis the commander and staff may be able to brainstorm a number of options, narrow down the

[200] Thunholm, "Planning Under Time Pressure: An Attempt Toward a Prescriptive Model of Military Tactical Decision-making," 51.

[201] Thunholm, "Military Planning and Decision-making Under Time-pressure: A Scenario Based Experimental Comparison Between Two Models," (unpublished paper, National Defence College, 2003), 16, https://www.researchgate.net/profile/Peter_Thunholm/publication/253520358_Military_Planning_and_Decision_Making_Under_Time-pressure_A_Scenario_Based_Experimental_Comparison_Between_Two_Models/links/55dc2c4d08aec156b9b0065f.pdf.

selection to those that are truly distinguishable, and then have the commander choose one, or amalgamate several options into a single course of action, for further development.

A second improvement would be to integrate baseline data into decision-making. Referring to the findings of Kahneman, there is a tendency of decision makers to avoid the use of data from similar situations which prevents an understanding to the underlying statistical norms of any particular situation.[202] Doctrinally, the CA supports the use of operational research for decision-making.[203] Similar to the efforts by Dupuy to create a formula for combat based on the quantification of historical data, and Soviet approaches to tactical quantification, a database with results from history, and potentially high fidelity force on force training, could provide a statistical base line of data to commanders and staffs who find themselves in similar situations.[204] This would not be a "solution book" but a reference to compare proposed courses of action to gain insight into probabilities of success in a specific situation. Such a database would require significant operational research, quantification, and categorization, to allow staffs to easily access and understand the data. Admittedly, the complexity and qualitative nature of battlefield factors make such an initiative difficult. Despite this, a wide ranging, thorough analysis of battlefield results could only help the professionalism of the CA and support the training initiatives required to move from a training system focused on the execution of the procedures of the OPP to one focused on the expertise required for intuitive decision-

[202] Kahneman, 146-155.

[203] Department of National Defence, B-GL-331-001/FP-001 *Command Support in Land Operations*, (Ottawa: Department of National Defence, 2008), 6-21.

[204] Dupuy, xxi; Fastabend, 24; Tedesco, 42-43. The Superforecasters also consistently referred to statistical base rates to make their predictions, Tetlock and Gardiner, 117-120.

making. Ultimately, such a resource would not be perfect, but would be helpful to commanders on operations.

Third, are the techniques of the commander's interview and the pre mortem. The commander's interview is a process where the commander explicitly states why they have chosen an option.[205] This "process provides an organized method for staff members as well as subordinate commanders to question the commander's thinking behind the COA."[206] While this approach allows the staff, and potentially subordinates to understand the commander's thought process, equally as important, if not more, it allows them to critically examine the commander's conclusions.

The pre mortem is a well-documented technique for defeating numerous biases with acceptance in both the heuristic and biases and naturalistic decision-making schools of thought.[207] This technique asks decision-makers and their staffs to individually envision a future where their chosen course of action has failed, and to describe why it has done so. This is an effective means to overcome group think, and to leverage the expertise of those in a group who maybe less inclined to contribute otherwise.[208] Within an RPM decision-making context, it is a means to challenge the intuition of the commander and either refine the operationalization of the chosen course of action to mend some vulnerabilities, or to reveal a fatal flaw that forces a re-evaluation and selection of a new course of action.

Lastly, are the tools of critiquing in the metacognitive approach to decision-making. When time is available, decision-makers should look to critique their intuitive

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[205] Karol G. Ross, et al., 9.
[206] *Ibid.*
[207] Klein, *Sources of Power*, 74-75; Kahneman, 264-265; Kahneman and Klein, "Conditions for Intuitive Expertise," 524; Karol G. Ross, et al., 9.
[208] Kahneman, 264-265.

decisions. Cohen, Freeman, and Thompson came up what they termed the STEP (Story, Test, Evaluate, and Plan) model to help in evaluating intuitive judgements. The model suggests that when intuitive assessments are made a story should be created for the assessment. A critique should then test the story which will result in amendments. The team can then evaluate the amended story to see if it remains valid, and if so planning can begin. If not, then the cycle should begin anew.[209]

Such an assessment could find three problems, incompleteness, unreliability, or conflict.[210] "An assessment is incomplete if key elements of a situation model or plan based on the assessment are missing."[211] Conflict takes place when new information conflicts with the current assessment.[212] Unreliability speaks to the assumptions underlying an assessment. If those assumptions are faulty or irrational than the assessment will be unreliable.[213] Critiquing is a method of combatting these potential errors in intuitive assessments. Over a series of experiments and interviews with US Army members on planning staffs and US Navy anti-air warfare officers, the method proposed by Cohen and his team is to use a series of questions where an imagined crystal ball tells you that parts of your assessment are incorrect, forcing you to critically examine the cues leading to your assessment to see if there is an alternate interpretation. These questions would be particularly helpful in novel situations.[214]

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[209] Marvin S. Cohen, Jared T. Freeman, and Bryan Thompson, "Critical Thinking Skills in Tactical Decision Making: A Model and a Training Strategy," in *Making Decisions Under Stress: Implications for Individual and Teams Training*, (Washington D.C.: American Psychological Association, 1998), 164.

[210] Marvin S. Cohen, Jared T. Freeman, and Bryan B. Thompson, "Training the Naturalistic Decision Maker," in *Naturalistic Decision Making*, ed. Caroline E. Zsambok and Gary Klein, (New York: Psychology Express, 2014), 449.

[211] *Ibid., 450*

[212] *Ibid.*.

[213] *Ibid.*

[214] *Ibid.*, 457-458.

There are two separate sets of questions, one relating to addressing certainty, and another for conflicting information. The certainty questions ask you to select an assessment then imagine that a crystal ball tells you that your assessment is wrong. Now you must explain how your assessment could be wrong. Lastly, the crystal ball again tells you that your new explanation is wrong forcing you to create another plausible explanation.[215] This forces decision-makers to critically examine the underlying assumptions of their assessments. In Cohen and his team's experience, staffs have been able to come up with numerous plausible alternate explanations which reveals that "the original assessment rested on the assumption that none of these exceptions was true."[216] The other set of questions relates to dealing with conflicting data. In this case decision makers are to notice events that do not fit with the current assessment. The crystal ball indicates these events fit the current assessment and should be made to do so in the simplest way possible while accounting for previous unexpected events. If the account is found not reliable then the decision maker should consider changing their assessment.[217]

Figure 4.2, below, illustrates an improved operationalized CA RPM, with the discussed techniques added based on the availability of time. At the conclusion of mission analysis, the planning team could conduct a brainstorming session to quickly identify all the potential options. The commander could then make their decision based on one of those options or some combination thereof and follow this by verbally giving their justification for selecting the course of action to ensure the staff understands the rationale behind the decision. Assuming there is sufficient time, the planning team could

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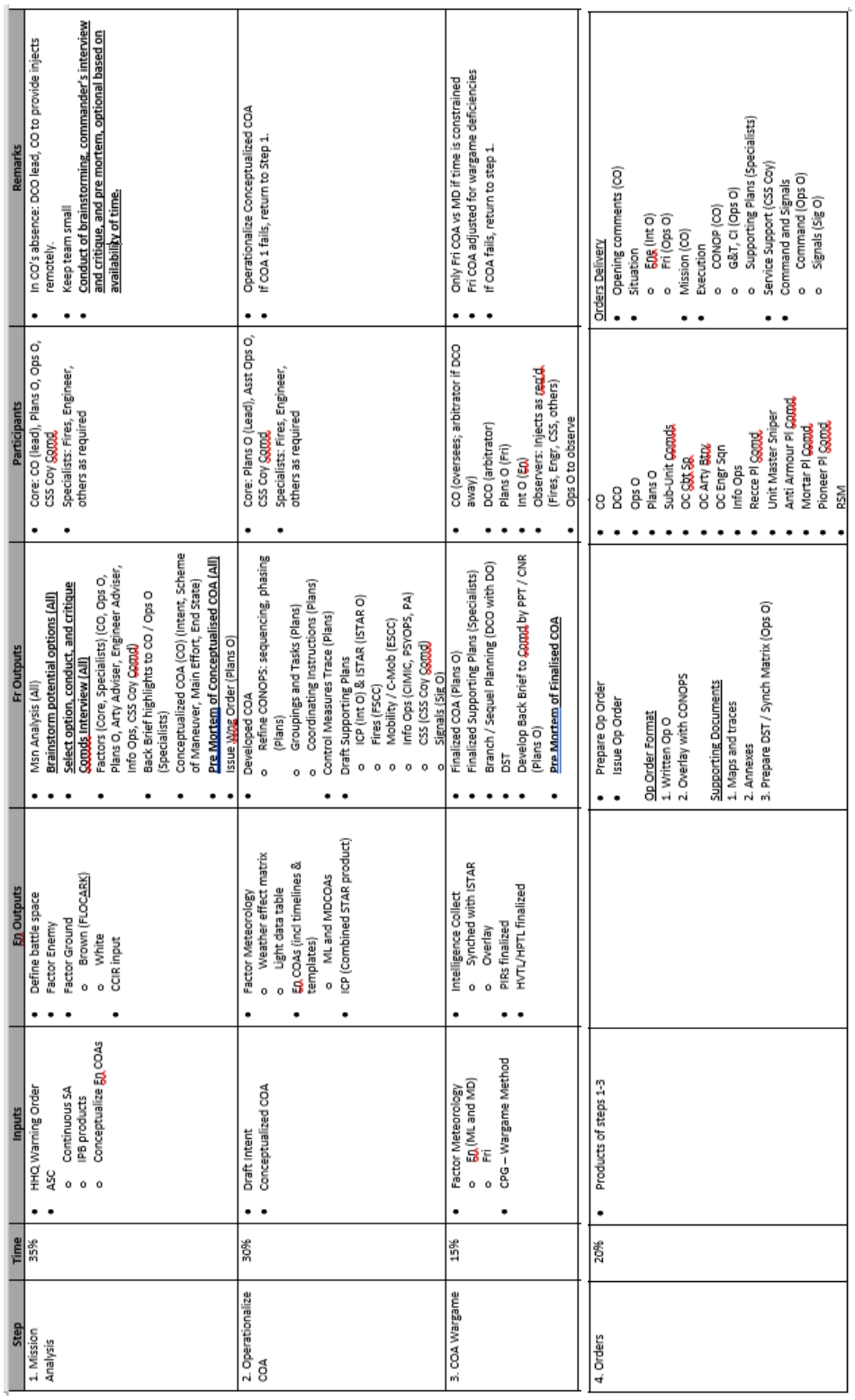
[215] *Ibid.*

[216] *Ibid.,* 458.

[217] *Ibid*., 460-461. Tetlock and Gardiner also found that their Superforecasters critically examined their intuitive assessments; Tetlock and Gardiner, 43-44, 123, 305.

subject the rationalization to Cohen and his team's metacognitive questioning techniques. Prior to concluding mission analysis, with a selected conceptual course of action, the team should conduct a pre mortem, separately writing their view of how the course of action could fail. Findings from this would carry forward into step two, operationalizing the course of action, or if a fault is found that it is not suitable, feasible, or acceptable, the commander could return to the list of outline courses created in the brainstorming session to select another. Throughout the planning process the planning team should employ the metacognitive questions to test the validity of intuition. The intelligence cell in particular should be using the questions associated with conflicting information to ensure their assessments remain as accurate as possible. The pre-mortem can continue throughout the process. At the conclusion of wargaming a pre-mortem could capture any remaining issues of what, at that point would be a complete, coordinated, course of action.[218]

[218] The use of the term 'coordinated' here as opposed to 'synchronized' is intentional. Synchronized implies a higher order of coordination with events tightly coupled in time and space. Tightly coupled plans are vulnerable to friction and hence disruption. Despite the popularity of the term synchronization in current doctrine and discussion, it is debatable that such a standard should be strived for in the complexity of combat. See, Department of the Navy, MCDP 5 *Planning*, 50-52; Colonel Chris Smith, "It is Time to Expunge the Word Synchronise from our Military Vocabulary," *Australian Land Power Form*, 29 August 2016, https://www.army.gov.au/our-future/blog/land-combat/it-is-time-to-expunge-the-word-synchronise-from-our-military-vocabulary.



Step	Time	Inputs	En Outputs	Fr Outputs	Participants	Remarks
1. Mission Analysis	35%	• HHQ Warning Order • ASC o Continuous SA o IPB products o Conceptualize En COAs	• Define battle space • Factor Enemy • Factor Ground o Brown (FLOCARK) o White • CCIR input	• Msn Analysis (All) • **Brainstorm potential options (All)** • **Select option, conduct, and critique Comds interview (All)** • Factors (Core, Specialists) (CO, Ops O, Plans O, Arty Adviser, Engineer Adviser, Info Ops, CSS Coy Comd) • Back Brief highlights to CO / Ops O (Specialists) • Conceptualized COA (CO) (Intent, Scheme of Maneuver, Main Effort, End State) • **Pre Mortem of Conceptualised COA (All)** • Issue Wng Order (Plans O)	• Core: CO (lead), Plans O, Ops O, CSS Coy Comd • Specialists: Fires, Engineer, others as required	• In CO's absence: DCO lead, CO to provide injects remotely. • Keep team small • **Conduct of brainstorming, commander's interview and critique, and pre mortem, optional based on availability of time.**
2. Operationalize COA	30%	• Draft Intent • Conceptualized COA	• Factor Meteorology o Weather effect matrix o Light data table • En COAs (incl timelines & templates) o ML and MDCOAs • ICP (Combined STAR product)	• Developed COA o Refine CONOPS: sequencing, phasing (Plans) o Groupings and Tasks (Plans) o Coordinating Instructions (Plans) • Control Measures Trace (Plans) • Draft Supporting Plans o ICP (Int O) & ISTAR (ISTAR O) o Fires (FSCC) o Mobility / C-Mob (ESCC) o Info Ops (CIMIC, PSYOPS, PA) o CSS (CSS Coy Comd) o Signals (Sig O)	• Core: Plans O (Lead), Asst Ops O, CSS Coy Comd • Specialists: Fires, Engineer, others as required	• Operationalize Conceptualized COA • If COA 1 fails, return to Step 1.
3. COA Wargame	15%	• Factor Meteorology o En (ML and MD) o Fri • CPG – Wargame Method	• Intelligence Collect o Synched with ISTAR o Overlay • PIRs finalized • HVTL/HPTL finalized	• Finalized COA (Plans O) • Finalized Supporting Plans (Specialists) • Branch / Sequel Planning (DCO with DO) • DST • Develop Back Brief to Comd by PPT / CNR (Plans O) • **Pre Mortem of Finalised COA**	• CO (oversees; arbitrator if DCO away) • DCO (arbitrator) • Plans O (Fri) • Int O (En) • Observers: injects as req'd (Fires, Engr, CSS, others) • Ops O to observe	• Only Fri COA vs MD if time is constrained • Fri COA adjusted for wargame deficiencies • If COA fails, return to step 1.
4. Orders	20%	• Products of steps 1-3		• Prepare Op Order • Issue Op Order Op Order Format 1. Written Op O 2. Overlay with CONOPS Supporting Documents 1. Maps and traces 2. Annexes 3. Prepare DST / Synch Matrix (Ops O)	• CO • DCO • Ops O • Plans O • Sub-Unit Comds • OC Cbt Sp • OC Arty Bty • OC Engr Sqn • Info Ops • Recce Pl Comd • Unit Master Sniper • Anti Armour Pl Comd • Mortar Pl Comd • Pioneer Pl Comd • RSM	Orders Delivery • Opening comments (CO) • Situation o Ene (Int O) o Fri (Ops O) • Mission (CO) • Execution o CONOP (CO) o G&T, CI (Ops O) o Supporting Plans (Specialists) • Service Support (CSS Coy) • Command and Signals o Command (Ops O) o Signals (Sig O)

Figure 4.2 – Modified RPM Process. Additions in bold and underlined.

The above discussion on tools to improve intuitive assessments was to find ways to tame the recognitional decisions that underpin RPM. These techniques would be exceptionally valuable in novel situations. They would require additional time in the planning process and so must balance against the requirements to act and adapt more rapidly than the enemy. The understanding of what can be realistically expected from planning in combat from the historical analysis, in conjunction with the discussion on RPM makes it clear that it is a realistic replacement for the OPP. RPM, particularly with the addition of the tools of brainstorming, the commander's interview, meta cognitive questioning, and the pre-mortem, is not, despite what some critics may argue, simply the commander and the staff abdicating their duties to conduct serious planning. Expertise will allow the commander and staff to develop acceptable solutions to problems without the requirement for the creation and comparison of multiple courses of action. Even in novel situations, with the additional critical thinking measures described above, the planning team will be able to use a single course of action and then subject it to analysis throughout the process.

Disadvantages of RPM

Outside of these improvements two downsides of RPM remain: the potential predictability of courses of action based on experience and the difficulty to instruct a system of decision-making more based on expertise than a process with a series products. Relying on experience to make decisions, particularly when consistently selecting the first option that comes to mind that satisfices, threatens to make one's actions

predictable.[219] Many of these first impressions are likely to be based on training and doctrinal approaches to problems. After an extended period of operations against an opponent the problem could become even more acute as the opponents learn more about each other's individual approaches to operations. There are a few means by which to mitigate this. First, using a methodology like RPM which employs only a single course of action approach should result in faster decisions. Units and formations can achieve surprise by achieving superior tempo, so, while the direction of attack as an example, may be predictable, surprise could still be achieved due to superior decision-making speed. Second, using the brain storming method in the mission analysis from the PUT model would help in infusing some divergent thinking into the process which could make a commander less predictable to the enemy. Lastly, deception measures should be consistently considered in mission analysis and the operationalization of the course of action.

Any process primarily oriented on the use of professional expertise over process will be more difficult to instruct. Current instructional methodologies focus on instructing the estimate and OPP. It is common to assert that the outcomes, the actual soundness of the plan produced, is less important than the learning of the process itself. Assessment has an aspect of having to "show one's work," like long division in elementary school. As an example, on the Army Tactics and Operations Course (ATOC) and the Army Operations Course (AOC) there are detailed assessments of the full work of the students estimates. The students must complete estimates in the factor, consideration, deduction format in laborious detail, resulting in estimates dozens of pages in length. The other primary method of assessment is that of briefings to the commander from the staff, which

[219] Klein, *Sources of Power*, 305.

gets students to focus on the contents of PowerPoint briefings over depth of analysis or the actual plan produced. It can also lead to a situation where students in training institutions are primarily exposed to a system where the commander is little involved in planning, their involvement limited to receiving briefings and providing some guidance. Such a system will not facilitate the gaining of expertise to maximize the use of intuition. Required changes to the training system will be discussed later in the chapter.

Independent of the adoption of RPM, the CA needs to investigate the use of Design as a means of dealing with complexity. While mission analysis involves the evaluation of direction from higher and relevant factors, Design is a broader, more wholistic, investigation to better understand the operational environment and to ensure that planners are solving the right problem. Design is non-reductionist in its analysis which prevents some of the simplification that comes from a structured factors analysis by staff section.[220] The CA currently has not officially adopted Design doctrinally, however, it is being instructed at the Canadian Forces College on both the Joint Command and Staff Program (JCSP) and the National Security Program (NSP). These efforts should continue, and the CA should look at following the US Army with the publication of its own Design doctrinal manual.

If the CA were to adopt RPM the role of the OPP would shrink significantly, however, it would not be without its use. As discussed previously, planning is a learning tool. A commander and staff who are not overly constrained by time, perhaps prior to a deployment, could choose to use the OPP as a means of raising the common

[220] Patrick C. Mulloy, "Penetrate Uncertainty: Descriptive Planning in a Complex Tactical Environment;"; Ben Zweibelson, "'The Enemy Has a Vote' and Other Dangers in Military Sense-Making," *Journal of Military Operations* 2 No 2, (Spring 2014), 22, https://www.tjomo.com/article/39/The_Enemy_has_a_Vote_and_Other_Dangers_in_Military_SenseMaking/; Taleb, 16; Czerwinski, 1-10.

understanding of the problem they face. Such an approach would likely use some Design techniques as well. Recalling the Cynefin framework, the OPP will most excel while solving complicated problems.[221] If the institution is seeking an optimal solution in such a context, then OPP will make an excellent tool. OPP is also good when it is required to explicitly justify one's decision, as well as to overcome conflict between competing stake holders.[222] One could imagine many institutional challenges of resource management fitting within this category. Lastly, the OPP will still be required for interoperability with partners and allies who all employ a decision-making methodology similar to the OPP. Even with the adoption of RPM, the CA will still require the OPP and it would be prevalent for institutional level decisions and planning with partners and allies.

The CA needs to adopt a recognitional based planning model. Klein's RPM is a well-developed system that could be further improved, where time allowed, with the addition of the tools of brainstorming, operational research data, meta cognition, and the pre mortem. The RPM allows commanders and staffs to plan in a way which is more conducive with the complexity, and time competitive nature of war. OPP will not disappear, but the CA will gain a greater appreciation for when which tools are best. To best exploit the RPM the CA will need to further improve the expertise of its officers. The paper will turn to this challenge next.

Building Expertise for Intuitive Decision-Making

[221] Snowden and Boone.
[222] Klein, "Strategies of Decision-making," 61; Klein, "Sources of Power," 99-100.

Intuitive decision-making relies on pattern recognition which requires expertise to recognize the cues present in a situation and pull a potential solution from memory. To make decision-makers effective in this decision-making strategy, the CA will need to modify the way it trains.

The first way to help in gaining in expertise is an approach to training focused on repetition. This returns to the concept of ***validity***. As argued in chapter 2, warfare is an environment similar to poker or another game of cards, where it is fundamentally uncertain, however, there are sufficient cues in the environment to enable the decision-makers to gain intuitive knowledge. According to Kahneman and Klein, in order to make intuitive decisions, decision-makers require sufficient exposure to these valid cues to be able to learn them.[223] The CA, therefore, should be aiming to expose officers to multiple repetitions of various activities in a variety of conditions as best emulating the conditions of warfare as possible. Currently the CA is good at this for a narrow band of operations, such as the hasty attack, however, there are few officers who have executed multiple reliefs in place, withdrawals, or an area defence, as an example.

Validation events are a challenge to this approach. Currently the CA uses the concept of 'validation' to allow commanders and their units to carry on to the next level of training.[224] Due to a combination of time and resource constraints as well as the desire to deliver a realistic validation experience, often, CA validations at the sub-unit level and below are conducted by observing single, live fire, events. They are almost universally deliberate or hasty attacks. Due to leaders understanding that their assessment as commanders, which impacts their career advancement, is based on one or two attacks

[223] Kahneman and Klein, 520.

[224] Department of National Defence, B-GL-300-008/FP-001 *Training for Land Operations*, (Ottawa: Department of National Defence, 2014), 6-3-12.

(often one by day and by night) they are incentivized to focus on this singular task at the expense of others. The fact that they are live fire ranges as opposed to force on force training is also problematic as live fire training is inherently less dynamic than force on force due to the lack of a live opponent working against the commander, as well as the safety requirements for live fire practice. At the battlegroup and brigade levels validation is more prolonged and is force on force, however, it is infrequent with brigades and their battlegroups only entering high readiness and being validated once every three years. This system does not allow for the repetition nor the breadth of experience to develop a commander who can best employ intuition to achieve rapid, effective decision-making.

The CA needs to modify this approach to one where performance over a variety of operations is emphasized vice just a single one. Validation on Exercise Maple Resolve for brigades and battlegroups is a good example of this. This will incentivize commanders to expand the number of operations on which they train, increasing experience across the spectrum of operations. Admittedly, there are limitations on the Army's ability to do this in the field for all formations, units, and sub-units, every year. There is simply not enough time and resources to put every brigade in the field every year to gain the sufficient repetitions to make every officer an expert at every tactical activity at their requisite level. Nor should commanders conduct all training within the construct of validation.

This implies that the CA must turn to exercises without troops to make the best use of the time available. Tactical Exercises Without Troops (TEWT) is common training practice within the schools of the CA. They often entail being given a complete order and require the production of an estimate, a back brief, an order, or some combination

thereof. The next tool is a Tactical Decision Game (TDG). They are similar to a TEWT but are consistently done with incomplete information and under significant time constraints. The incomplete information and time constraints are meant to emulate the realities of combat but they also make for a training tool that is easy to administer. As opposed to a back brief or estimate, output from a TDG is a solution to the problem in the form of an order to ones imagined subordinates. This focuses decision makers on the critical outcome of the planning process, actual orders to subordinates.[225] The execution of TDGs in schools, the field force, and even the institutional army is a means of quickly building repetitions on a variety of operations, in an uncertain time constrained environment.[226] The CA should also seek to revitalize wargaming. This would be different from wargaming as done during the planning process where the goal is to select or refine a course of action. This wargaming would be a force on force exercise, likely over a map or terrain model, between two officers or teams. This is the most demanding of the three options as there is a requirement for referees and standard sets of rules but also the most beneficial due to the free interplay of clashing human wills between the players. The UK is currently experiencing a renaissance of wargaming using the Camberly Kriegspiel module.[227] Recent candidates on the Tactics School's Combat Team Commander Course have been exposed to a similar wargaming experience and employed

[225] Major John F. Schmidt, "Are You the Next Napoleon? For Tacticians at the Tip of the Spear," *The Marine Corps Gazette,* 100 No. 7 (July 2016)

[226] For further information on TDGs see the forthcoming *Canadian Army Journal* article from the author, "Developing Coup D'Oeuil: Tactical Decision Games and their Value for the Canadian Army."

[227] Anthony Kirkham, "Planning Isn't Everything: We Need More Focus on the Execute," *Wavell Room*, 22 Oct 2019, https://wavellroom.com/2019/10/22/planning-isnt-everything-we-need-more-focus-on-the-execute/

it within their home units.[228] While computer assisted exercises can be expensive, a wargame can be done with the required personnel and a set of maps. Wargaming is a superior tool for exposing officers to the dynamics of actual conflict due to the force on force nature of the exercise. All three of these tools are means by which the CA can begin, at little to no expense, while in garrison and at schools, to increase the repetitions of its officer corps to improve their aptitude for making intuitive decisions. Wargaming offers not only an increased number of repetitions but also to expose officers to the dynamic interplay of clashing forces inherent to actual combat, which is not available outside of high-fidelity force on force training and actual combat experience.

To maximize the experiences gained through a new training approach focused on repetition, there needs to be an equivalent focus on coaching, and self-reflection. Through the after-action review (AAR) process the CA has already institutionalized the use of critique following training events, where the leader, subordinates, and superiors make comments on points to improve and sustain. The CA must sustain the AAR and improve upon it through a robust culture of improvement and focus on process feedback vice outcome feedback. It is insufficient to say that a particular outcome was deficient, as this does not tell a decision-maker how to improve. Leaders need to focus their feedback on what behaviour is required to lead to success.[229] This is fairly straightforward when observing soldier skills, or immediately observable activities, however, when it comes to the cognitive actions of planning, and command, a leader requires a closer more

[228] 2 RCR executed two wargames in 2019 as part of 2nd Canadian Mechanized Brigade Group's (2 CMBG) professional development program. The expertise to run the games were provided by two Captains who had participated in several games on the Fall of 2018 Combat Team Commander Course.

[229] Klein, *Streetlights and Shadows*, 165-166.

reciprocal relationship and an exchange between the mentor and mentee to determine how a decision-maker conducted their planning and arrived at a decision.

The CA needs to engender a culture of self-improvement where officers seek to maximize their gains from each training activity, which includes TEWTs, TDGs, and wargames as well as more traditional training forms. In the words of Klein, the CA should seek to teach its officer to "learn like experts."[230] This approach involves engaging in deliberate practice with identified outcomes, timely and accurate feedback, and a review of prior experiences to seek additional lessons.[231] Self-reflection and journaling are a means by which officers can draw more out of there experience. Later in their careers, after having accumulated further knowledge and experience, returning to their journals will allow them to glean even further lessons than was originally possible. Disciplined journaling is a process with the potential to pay continued dividends throughout a career. Such a change will require mentorship by CA leaders.

A deliberate approach to self-reflection is required, to get the most out of such activities. Josh Waitzkin is an eight-time US chess champion, achieving master rank in his youth. He was also the inspiration for the main character of the *Search for Bobby Fischer*. He now runs a company where he does highly individualized mentorship for elite performers to help them become the best within their field.[232]

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[230] Klein, *Sources of Power*, 108.
[231] *Ibid.,* 108-109.
[232] Brand-Katalyst Creative, "The Art of Learning – Josh Waitzkin," accessed 9 March 2020, https://www.joshwaitzkin.com/josh.

> These moments where the technical and psychological collide, are where I directed my study of the game. In the course of a nine-round chess tournament, I'd arrive at around four or five critical positions that I didn't quite understand or in which I made an error. Immediately after each of my games, I quickly entered the moves into my computer, noting my thought process and how I felt emotionally at various stages of the battle. Then after the tournament, armed with these fresh impressions, I went back to Vrholvje [Waitzkin's coach] and studied the critical moments… Usually long study sessions went like this: I began with the critical position from one of my games, where my intuitive understanding had not been up to the challenge. At first my mind had been like a runner on a cold winter morning – stiff, unhappy about the coming jog, dreary. Then I began to move, recalling my attacking ideas in the struggle and how nothing had fully connected. I tried to pick apart my opponent's position and discovered new layers of his defensive resources, all the while my mind thawing, integrating the evolving structural dynamics it had not quite understood before… When I looked at the critical position from my tournament game, what had stumped me a few days or hours or weeks before now seemed perfectly apparent. I saw the best move, felt the correct plan, understood the evaluation of the position. I couldn't explain this new knowledge with variations or words. It felt more elemental, like rippling water or a light breeze. My chess intuition had deepened.[233]

In terms of intuitive capabilities, consider that Waitzkin, was able to play multiple rounds of timed chess simultaneously, moving from board to board, spending mere moments at each before making his move. Such a disciplined approach within the leadership corps of the CA would facilitate the rapid accumulation of expertise to enable intuitive decision-making, not to mention the potential benefits in leadership the approach would capture. Leaders should encourage their subordinates to share their experience to prevent them from being limited to a single officer's journal. The after-action review process is good for this, but the sharing of such experiences must go beyond those who participated in the training. Further, this is where military history becomes relevant. While every situation is unique, the study of military history offers some similar benefits as critically examining one's own experiences. In a peace time army the profession must see the studying of

[233] Josh Waitzkin, *The Art of Learning: An Inner Journey to Optimal Performance*, (New York: Free Press, 2007), 73-74.

military history as critical to gaining vicarious experience in that rare event, actual combat.

Accepting these measures may be difficult culturally. Doctrinally the CA accepts the complexity and chaotic nature of combat, but in practice there is a tendency to attempt to control what is uncontrollable vice accepting it, training to live with it, and ultimately, exploit it. The OPP as a linear, reductionist, problem-solving tool is indicative of such a culture within the CA. These methods, and the associated emphasis in training on the process itself, are comforting as they imply that the complexity of combat is irrelevant because if decision-makers follow the process they will get the right answer. As this paper has revealed, the truth is much more complicated and the CA should inculcate a culture which understands that in combat there will be no controlling complexity, but instead coping with it.[234] Adaptation has been another key theme throughout the paper and there is no adaptation without experimentation, and there can be no experimentation absent some failures. Doctrinal concepts such as the Manoeuvrist Approach and Mission Command, underwritten by trust between superiors and subordinates, would seek to encourage experimentation, so, CA leaders must ensure they embody the principles that these concepts demand.[235] Experimentation is further enabled by proper resourcing of training, particularly time. A reduced emphasis on one-time, major event, validations would help yield the time to incentivize experimentation by making the training environment more conducive to failure.

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[234] Czerwinski, 37.

[235] Department of National Defence, B-GL-300-001/FP-001 *Land Operations*, (Ottawa: Department of National Defence, 2008), 5-73 – 5-74, 5-75 – 5-76; Department of National Defence, *Command in Land Operations*, 2-5, 2-9, 2-19

Artificial Intelligence and Planning

The paper would not be complete without a discussion of the potential for significant impact from the development of Artificial Intelligence (AI) aids to decision-making. Considering the research discussed in chapter 1, a system that can process data more rapidly than the human brain, in the absence of the heuristics and biases that can plague humans is obviously an attractive opportunity. Recent years have seen significant increases in the capability of algorithms to predict behaviour and are being heavily leveraged in the private sector. The CA will need to investigate the decision-making potential of AI to ensure it remains competitive with adversaries and interoperable with its allies. This section of the paper will limit its analysis to the short to mid term and limited AI. A general intelligence AI would likely have a dramatic impact on planning, the character of war, and even potentially, the nature of war itself. This is beyond the scope of this paper.

The literature on AI is diverse in opinion on just what to expect of AI in terms of its ability to conduct decision-making. It has been known since 1954 that algorithms, under specific conditions, can often outperform humans indicating that decision-making may not be the sole province of human beings.[236] Further, AI will not experience heuristics and biases unless humans program them with them.[237] In this way the advantages of AI are evident but also extend to the fact that AI cannot be overwhelmed by data the way a human can. In fact, the more data an AI is exposed to the better,

[236] Kahneman, 222-225, 232-233.

[237] This has in fact been a problem with some algorithms. These programs can only use data which humans provide them, which are a product of imperfect human decisions. This suggests that in some contexts there could continue to be limits to the competence of AI decision-making along the same lines as those of humans. See, Navneet Alang, "Turns Out Algorithms Are Racist," *The New Republic*, 31 August 2017, https://newrepublic.com/article/144644/turns-algorithms-racist

allowing deep learning to refine whatever task it has been designed to perform. Having said this, research into AI is not entirely novel and has seen significant ups and downs. While there is considerable momentum behind AI currently much of the hype surrounding it is similar to that discussed in 1958 and during other AI boom periods.[238] While some prominent thinkers, such as Elon Musk, and the late Stephen Hawking, are concerned about the existential risks of AI and the emergence of a General Intelligence AI, others see it being limited to very narrow functions which prevents true problem solving.

Currently, AI is predominantly made up of algorithms that are able to conduct deep learning with exposure to large amounts of data. AI are now able to identify objects in photographs by virtue of understanding the commonality of the groupings of pixels. This requires thousands or millions of exposures.[239] AI have also been able to beat world class players at both the game of Go and Starcraft 2 after having played against itself millions of times.[240] Opinions diverge on what we can expect AI realistically to be able to achieve. Keith Dear, a UK intelligence officer, discusses AI enabling "cognitive manoeuvre" which he describes as providing such significant foresight that at its most capable could resemble the precognitives in the science fiction movie *Minority Report* who could see into the future to allow for pre-emptive arrests of suspects.[241] The other

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[238] Robert Richbourg, "'It's Either a Panda or a Gibbon': AI Winters and the Limits of Deep Learning," *War on the Rocks*, 10 May 2018, https://warontherocks.com/2018/05/its-either-a-panda-or-a-gibbon-ai-winters-and-the-limits-of-deep-learning/

[239] M.L. Cummings, *Artificial Intelligence and the Future of Warfare*, (London: Chatham House The Royal Institution of International Affairs, 2017), 8, https://www.chathamhouse.org/sites/default/files/publications/research/2017-01-26-artificial-intelligence-future-warfare-cummings-final.pdf

[240] Keith Dear, "Artificial Intelligence and Decision-making," *The RUSI Journal*, 164 No 5-6: 23.

[241] *Ibid*., 20.

side of the spectrum argues that AI is incapable of knowledge based reasoning.[242] AI in its current incarnation is reliant on the data it is fed. Poor quality data, or insufficient data will result in poor performance as they lack the capability to conduct induction, to form general rules from specific pieces of data.[243] Nor is AI able to determine causation. They correlate based on the frequency of data points but do not understand how one piece of information may cause an actual event. An example of this is chess playing AIs who learned by observing masters developed a tendency to sacrifice their queens early in the game. This happened because in games between masters, the sacrifice of the queen often resulted in a decisive move by the player making the sacrifice. The AI came to associate sacrificing the queen with winning without understanding that masters only do so when it will create conditions for success.[244] The complex nature of war where causation is opaque even to human military officers would make this challenge even more acute. The utility, then, of AI will be linked to human ability to understand the interactions of war and then to be able to quantify and categorize data for input to an algorithm.

It seems likely that much of the analytical analysis and procedures currently associated with planning is ripe for automation. Things like factors analysis and resolution of wargaming results could be left to AI to analyze freeing human decision-makers to conduct more creative tasks associated with design, mission analysis, course of action development and selection. Agrawal, Gans, and Goldfarb, all professors at the University of Toronto Rothman School of Business, and members of the Creative Destruction Lab, in their book *Prediction Machines* argue that AI will take over much of

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[242] Cummings, 7.

[243] *Ibid*.

[244] Ajay Agrawal, Joshua Gans, and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence,* (Boston: Harvard Business Review Press, 2018), 63.

the requirements in prediction but increase the demand for judgement which only humans will be able to provide.[245] Within their argument, prediction refers to the probability of a particular outcome while judgement refers to the "the relative pay off associated with each possible outcome, including those associated with "correct" decisions as well as those associated with mistakes."[246] Another important element of judgement would be determining just what decision-makers want AI to predict and how AI should integrate into planning. Determining this requires an understanding of what the organization's objective is and the relevant indicators that accompany its accomplishment and an understanding of what can be realistically predicted by the AI in the operational environment.[247] Similarly, Keith Dear, a Royal Air Force intelligence officer, has argued that AI will force humans to be better able to justify their decisions. As AI becomes more sophisticated and is able to provide quantifiable probabilities, human decision-makers will need to explicitly rationalize their decisions, particularly those that might be in opposition to the AI.[248]

These findings align with those earlier in the paper. If AI stands to conduct much of the analytical heavy lifting with human input coming in the way of judgement regarding problem identification, the value and risks associated with various outcomes, and direction to AI on predictions to make, then human-decision makers need to be experts in their particular area of the employment of force. As noted previously, this would necessitate a training approach and culture oriented towards creating expertise and less oriented on the execution of procedures. Such a human-machine pairing would place

[245] *Ibid.*, 81-82.
[246] *Ibid*., 75.
[247] *Ibid*, 140.
[248] Dear, 24-25.

a premium on the human's ability to direct the AI to make the appropriate predictions. The problems of complexity discussed in chapter 2, however, do not disappear with AI. Sensitivity to initial conditions is a reality no matter who or what is analyzing the data. The more synthesis of numerous factors and the further into the future humans ask AI to predict the less accurate it will be. Researchers will need to determine just how accurate prediction by AI's can be, to what tasks they are best suited, and how to integrate them into planning.

Conclusion

The implications from the previous three chapters are numerous. The CA needs to adopt the RPM. Tools such as the pre mortem and metacognitive questioning techniques will help in improving decisions from that process. A training methodology must be adopted to support leader's ability to successfully employ the RPM. It must be based on repetition, exploiting TDGs and wargames, supported by a re-invigorated culture of self-improvement to develop the requisite expertise to make recognitional decisions. The CA must also investigate and be prepared to exploit the burgeoning possibilities of AI.

CONCLUSION

Plans are worthless, but planning is everything.

- Dwight D. Eisenhower in his speech to the
National Defence Executive Reserve Conference, 14 November 1957

Human cognition is limited making the creation of optimal solutions to problems impossible, however, the complexity and dynamism of combat make such a criteria unnecessary. The OPP, however, seeks this optimality and units and formations consume significant time and effort in executing it. There are, however, other planning methodologies, such as RPM, that the CA should adopt to increase decision-making speed while maintaining the decision quality. Along with the adoption of the RPM the CA must also adjust its approach to training to further increase expertise, thereby enabling the intuition which enables recognitional decision-making.

Chapter 1 discussed human cognition generally through the findings of the heuristics and biases and naturalistic decision-making schools of thought. It relied heavily on the findings of Daniel Kahneman and his findings on human cognition being divided between the irrational, bias riddled, but rapid Type 1 processes and the rational but slow, lazy, and easily distracted Type 2 were introduced. The paper showed that human decision-making is based on the interaction of these two processes with the heuristics and biases of Type 1 thinking often being dominant as people fail to engage their deliberate System 2 processes to critique the impressions produced by their System 1. This was also demonstrated to be present in expert professionals with algorithms often producing equal or better decisions. Conversely research by naturalistic decision makers point out how professionals in operational environments are often able to make good decisions rapidly by relying on impressions created by their Type 1 processes. Gary Klein created the RPD

model to explain how these experts were making decisions, then later in conjunction with Marine Major Schmitt, created the RPM to operationalize Klein's findings for the military. This process relies on a satisficing approach vice the optimization of the OPP. Lastly, the findings of Kahneman and Klein's collaboration was discussed. They agreed that intuition was simply recognition and that to build expertise in a manner where intuition was useful a person would need to be working in a field with sufficient ***validity***. Validity was seen as the statistical relationship with causality in the field where the cues that indicate what might happen could be actually perceived and learned. A decision-maker would also require the opportunity through sufficient exposure to learn those cues.

Chapter 2 sought to establish warfare as a sufficiently valid environment to allow for the acquisition of intuition. To do this war as a complex environment was discussed through the lens of Clausewitz's *On War*, CA doctrine, and complexity theory and nonlinearity. Further it was found that this complexity led to significant unpredictability. This unpredictability, however, was bounded in time, with prediction becoming increasingly less accurate the further forward in time they are made. The validity of warfare was found in the research of Klein and his associates on the use of recognitional approaches in military training, ability of militaries to create doctrine based on previous successful operations, and the Soviet's and Dupuy's approach to the quantification in doctrine and aids to military decision-making. The findings of the chapter led to the conclusions that decision-makers must be able to simplify the operational environment into a mental model that is close enough to enable them to make a decision, an environment of the complexity of combat does not allow for plans to be optimized, and that the best way to gain a better understanding of a complex system is to interact with it.

These conclusions imply an approach to operations where planning is rapid and satisfices, and units and formations are highly adaptable.

In considering the findings of chapter 1 and 2, chapter 3 argued the problems with the OPP. The chapter reviewed the steps of the OPP and argued that it is a reductionist method of looking at problems. It categorizes problems and stovepipes their analysis by staff sections which can prevent fulsome understanding of the linkages between factors in the operating environment. This approach prevents an understanding of complexity and nonlinearity, and the practices of creating multiple courses of action, and the comparison of those courses reflects an approach to problem solving which seeks optimal solutions. The complexity and dynamism of combat, however, makes such an approach a waste of time and effort. Further, if solutions are fairly similar, then what decision-makers choose is likely irrelevant, while if they are far apart there is often a clearly preferable option which makes comparison superfluous. The optimization approach also requires more time to complete and the time competitive nature of war makes faster approaches to decision-making preferable. As the CA only recognizes analytical decision-making models, training is focused on the execution of these processes. This focus results in training concentrating on executing the processes and creating the products associated with the OPP and the estimate. Unfortunately, training on these processes increase competence in their execution but does not necessarily increase tactical decision-making expertise, meaning a recognitional approach to planning will necessitate a different approach to training.

The final chapter brought together several recommendations based on the findings of the previous chapters. The first recommendation is that the CA must adopt a

recognitional planning approach to planning similar to Klein's RPM that would better leverage expertise, make faster decisions, and allow for more rapid adaptation. A further operationalized version of the RPM already used by CA units was introduced. To support such a strategy of decision-making, amendments to the CA approach to training were discussed that would see a greater emphasis placed on repetitions, coaching, and self-reflection. To strengthen the RPM and insulate it from poor intuitive judgements a number of other techniques were suggested to be included in the RPM. These include option generation, the pre mortem, metacognitive techniques of the STEP approach, integration baseline statistical data, and the commander's interview. The OPP would remain relevant in the CA despite the adoption of the RPM. It would still be required for complicated problems where explicitly justifying one's decision is required as well as for work with partners and allies. Lastly, the implications of AI to the future of planning were discussed. AI holds the potential to automate some planning functions and making human expertise more valuable. The value of human expertise will be directed toward problem identification and definition and deciding what the AI will look to predict and calculate.

While a significant body of research already exists in this field, much of it is qualitative and little of it is Canadian. Further study could seek to gain greater quantitative data on the advantages of a recognitional approach to planning and place it within a Canadian context. Such a study should seek to identify the differences in time required and how the time is used differently between the two planning approaches while assessing decision quality.

In the beginning of the paper several successful commanders were discussed who made rapid intuitive decisions, absent of a process similar to the OPP. How this was possible and why it is desirable has been clarified by this paper. To create Canadian Pattons, and MacArthurs the CA needs to enable intuitive decision-making by investing in the expertise of their decision makers and enabling them to use it. The future operational environment, just like in the past, will demand it. The CA must heed the call.

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