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How We Think: Embracing Complexity in Canadian Armed Forces (CAF) Policy

The Canadian Armed Forces is systemically unable to solve complex problems. The planning methodologies provided in the CAF are better suited to non-complex problem contexts. Institutionally incorporating methodologies for solving complex problems will provide a capability to improve many long-standing CAF issues.

There are multiple problem contexts that exist in the military. In their 2007 Harvard Business Review article, Snowden and Boone break down problems into five broad categories including simple, complicated, complex, chaotic and disordered.[1] They suggest that each of these different contexts requires a different type of response, yet in the military we do not have processes suited for the complex context. This paper argues that by limiting how the institution can think about problems, innovation and effective solutions are being prevented from being executed. First, we will define and explore some difference in complex problems compared to other types of problems. Next CAF problem solving processes will be discussed as they relate to complex problems. Finally, some key pieces of complex problem-solving methodologies will be briefly explored before ending with some key areas requiring institutional change prior to the widespread acceptance of emergent and complex solutions.

The Director of the Complexity Group at the London School of Economics Eve Mitleton-Kelly notes that "complex problems that appear intractable may often be the result of inadequate or inappropriate approaches".[2] She continues on to highlight that

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[1] David J. Snowden and Mary E. Boone, "A Leader's Framework for Decision Making." *Harvard Business Review* (Nov 2007).

[2] Eve Mitleton-Kelly, "Effective policy making: addressing apparently intractable problems." *Handbook on Complexity and Public* Policy edited by Robert Geyer and Paul Cairney (Cheltenham: Edward Elgar Publishing, 2015), 126.

understanding the problem space, the multiple dimensions and "co-evolving dynamics of critical clusters" then allows the connectivity, inter-dependence, feedback and most importantly emergence to be understood.[3] In the same publication, Geyer and Cairney suggest that breaking down all problems into component parts is "fatally flawed because complex systems are greater than the sum of their parts" and the interactions between elements "cannot simply be attributed to individual parts of a system".[4]

HOW WE THINK

While introducing their categories of problem contexts, Snowden and Boone suggested that "managers rely on common leadership approaches that work well in one set of circumstances but fall short in others".[5] The CAF does use different methods to solve problems including the Operational Planning Process, Commander's intuition, analysis by experts and more recently some limited forays into design thinking. These processes are well-suited for some problem contexts, but not well suited for others, most notably complex problems. Table 1 provides a summary of Snowden and Boone's category definitions.

Problem Context	**Characterized by**	**Decision Reached by**	**Domain of**
Simple	Stability, clear cause-and-effect.	Self-evident, undisputed and simple consensus.	Known knowns, and best practices.
Complicated	Multiple right answers, clear cause-and-effect but not visible to all.	Fulsome analysis by experts.	Known unknowns, analysis and expertise.
Complex	Unknown "right" answers. Difference between Ferrari	Complex system management, heterogeneous	Unknown unknowns, emergent and evolving solutions.

[3] Ibid.
[4] Robert Geyer and Paul Cairney, *Handbook on Complexity* (Cheltenham: Edward Elgar Publishing, 2015), 2.
[5] Snowden and Boone, *A Leader's Framework for Decision Making*.

	(complicated) and Rainforest (complex). Constant flux. More than sum of parts.	stakeholders, interdisciplinary analysis and eco-system-based inputs.	
Chaotic	Constantly shifting cause-and-effect with no manageable pattern, turbulence.	Leader's instinct, no/minimal input. Immediate triage so that problem can change from chaotic to complex.	Unknowables, rapid response and decisive action to establish order.
Disorder	Unclear which of the other four contexts is dominant.	Converting to another problem context.	Experience and intuition.

Table 1. Summary of problem contexts from Snowden and Boone[6].

From the table above, we can see that simple, complicated, chaotic and disorder problem contexts already have suitable processes in the CAF using standard operating procedures for simple problems, the operational planning process (OPP) for complicated problems and Commander's experience for both disordered and chaotic problems. But there is a gap for complex problems, a gap that often sees OPP imposed to break down a problem when the context in fact calls for the opposite. In their book *Nudge*, Thaler and Sunstein comment that as choices become more numerous, "people are likely to adopt simplifying strategies" and select certain structures to help make decisions .[7] These structures however affect outcomes. There is a connection between the parts in complex problems and those connections are lost in any reductionist strategy. The key to complexity therefore is to model, analyze and evaluate the feedback cycles between aspects of the problems to find emergent properties or "behaviour that results from the interaction between elements".[8] These interactions are not likely to be fully predictable. Grisogono suggests that it is "impossible to be sure of exactly what conditions to set and

[6] Ibid.
[7] Richard H. Thaler and Cass R. Sunstein, *Nudge* (New York: Penguin Group, 2009), 102.
[8] Geyer and Cairney, *Handbook on Complexity*, 2.

actions to take to achieve specified desired outcomes while also averting unwanted outcomes".[9] The result of all these aspects of complexity is an inability to determine a sole right answer from the initial conditions of the problem. This inability drives an iterative problem-solving methodology making it increasingly important to select the right *method* because the right *answer* is not possible at the start.

Iterating towards a solution means that the initial solutions will fail in part or in full. This adds a layer of social complexity to the problem-solving process as failure is not always seen to be the key factor that it is for innovation, especially in a military hierarchy. Price and Haynes note not only that failure is always a possibility but that recent thinking suggests that failure is an emergent process of a system and that most things in fact fail.[10] Acceptance of failure, rapid iteration and complexity must be supported at command ranks for real solutions to complex problems to be implemented successfully.

The complex problem context also requires "more interactive communication than any of the other domains".[11] Dissent and diversity of opinion must be encouraged, and further incorporated into solutions. While discussing courses of action (COA) development, Heltberg and Dahl highlight that "most militaries today harbour an inherent tension" between innovation and the "highly codified hierarchical structures" of the organization.[12] The culture that the hierarchy produces tends to be conservative and

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[9] Anne-Marie Grisogono, "On the roles of design in Defence", *Design Thinking: Applications for the Australian Defence Force, Joint Studies Paper Series No.3* edited by Aaron P. Jackson (Canberra: ADC Publications, 2019), 73.

[10] Jim Price and Philip Haynes, "The policymaker's complexity toolkit". *Handbook on Complexity and Public Policy*, edited by Robert Geyer and Paul Cairney (Cheltenham: Edward Elgar Publishing, 2015), 105.

[11] Snowden and Boone, *A Leader's Framework for Decision*.

[12] Therese Heltberg and Kare Sveistrup Dahl, "Course of Action Development – Brainstorm or Brickstorm", *Scandinavian Journal of Military Studies* (DOI: https://doi.org/10.31374/sjms.30), 165.

"reliant on linear-thinking doctrines…[with] a factual notion of knowledge" that privilege's previous experience.[13] This leads to an undervaluing of iteration, communication downward in the problem definition stage and ultimately failed attempts to resolve complex problems. During problem definition efforts, Heltberg and Dahl's research found that ideas from military brainstorming sessions were not blended together into new solutions instead, coining the term "brickstorm", they show that each idea remains itself and while it may or may not be added into the solution, the ideas are not transformed in the exchange between participants as was the intent of a brainstorm.[14] Heltberg and Dahl continue:

> Most military tools of analysis…aim at reducing complexity to enable decision-making, and they rely on a perception of knowledge as definite. This is underpinned by an organisational culture which largely supposes that there is right and there is wrong, and that commanders are supposed to possess superior or more extensive knowledge than their subordinates.[15]

In training this arises as the Directing Staff (DS) solution that CAF members are eager to know at the end of any exercise. Heltberg and Dahl continue that this DS solution "hampers curiosity" and leads to divergent ideas being rejected early in the process. The default therefore becomes the status quo, convergent ideas are laid on top of the status quo while divergent ideas are shunned. Challenging the status quo can easily be tied to challenging leadership and in such a rigid hierarchy either disappear through indoctrination or through the departure of members that cannot conform.

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[13] Ibid.
[14] Ibid, 166.
[15] Ibid, 169.

The rigid linear hierarchy extends into military problem-solving processes. The OPP in particular is "loaded with precision and certainty…and by certain analytical and decision-making templates" including factor analysis, war-gaming and decision matrices.[16] This precision and certainty is imposed where none exists in a complex problem.

RETHINKING THE THINKING PROCESS

Once the CAF has accepted that a new methodology is required to handle complex problem contexts, it will need to implement a new process. This will not be like implementing a new military capability because it is not just changing how we fight, but it is fundamentally changing how we think about a problem space. At this point it is instructive to use an example of a complex problem space, a complex problem-solving methodology and to see how it interacts practically with the current CAF command processes. Specifically, the retention of fighter pilots in the RCAF is a complex problem. An advantage of a complex problem is that there need not be one single starting place. The connections and interactions between parts of the problem mean that any place can be used as a start to build the initial picture and interactions. Givel comments that "emergent phenomena are sensitive to the initial policy situation…and are influenced by numerous negative or positive feedback loops"[17] which suggests describing the initial situation then identifying these negative and positive feedback loops are the first step. Figure 1 shows a description of initial conditions and feedback loops for the RCAF fighter pilot retention problem.

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[16] Ibid, 172.

[17] Michael Givel, "What's the big deal?: Complexity versus traditional US policy approaches". *Handbook on complexity and Public Policy*, edited by Robert Geyer and Paul Cairney (Cheltenham: Edward Elgar Publishing, 2015), 65.

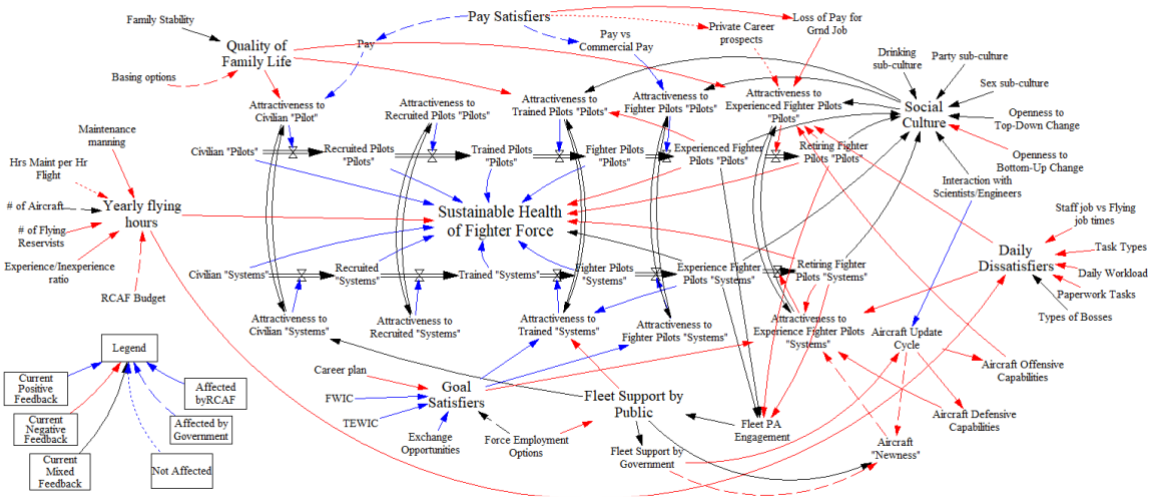

Figure 1. Causal loop diagram showing the feedback loops in the RCAF fighter pilot retention problem.[18]

Figure 1 is an important step to set the initial conditions of the problem, and to identify some of the interactions and feedback loops, but it is not to be considered the final version. As Sebastian Thrun, cofounder of Udacity noted "iteration is key to innovation…you need to believe that the answers can't be known in advance and thus embrace "emergence" as the vehicle of solving".[19] Once we have this initial representation of the starting conditions, we can use methodologies from complexity science to take the next step. In his TED Talk, the ecologist Eric Berlow suggests that we can target a critical node for influence then look one, two or three degrees away to find the most opportune areas to influence.[20] In figure 1, there are four key negative feedback loops affecting the sustainable health of the fighter force including the yearly flying hours, the transition from fighter pilots to experienced fighter pilots and the transitions

[18] Ryan Kastrukoff, *Royal Canadian Air Force fighter pilot causal loop diagram* (unpublished, 2019).
[19] David Benjamin and David Komlos, *Cracking Complexity* (London: Nicholas Brealey Publishing, 2019), 122.
[20] Eric Berlow, *Simplifying complexity* (TEDGlobal 2010: https://www.ted.com/talks/eric_berlow_simplifying_complexity/up-next?language=en#t-175636).

from experienced to retiring pilots in both the "pilot" and "system" streams. The scope of this paper does not include a detailed explanation of the fighter pilot retention problem space, instead we focus on the problem-solving process and to that end we take figure 1 as the initial definition of the problem, identify some key areas of potential influence and move on to the next stage, stakeholder engagement.

Thaler and Sunstein suggest that "social influences come in two basic categories": first information and what people already think or do, then second peer pressure and going "along with the crowd to avoid their wrath or curry their favor".[21] Givel adds that policymaking occurs simultaneously at different levels of government and that these policy attempts are interconnected further informing the required stakeholder engagements.[22] Finally, Price and Haynes describe how "there must be a degree of heterogeneity…in backgrounds, perspectives, heuristics and mental models" for novelty to emerge in solutions.[23] This does not provide an exhaustive list of personnel required for the problem solving team in contrast to the complicated problem context where the OPP defines relatively easily which experts need to be on the team after an initial orientation to the problem. All levels of complex problem solving are iterative from the description of the problem and problem space, to the composition of the team. By growing and shrinking the team targeting diversity, engagement and influencers, the required interactions can occur providing emergent solutions. This is not an easy process to accept culturally in a hierarchical military as it does not lend itself well to specific timelines, specific outputs and eventual decision briefs to a single commander who has

[21] Thaler and Sunstein, *Nudge*, 62.

[22] Givel, *What's the big deal...*, 75.

[23] Price and Haynes, *The policymaker's complexity toolkit*, 104.

authority over the entire problem set or solutions recommended. But these small (or large) influences in different areas of the problem ecosystem have been proven to be successful.

In an Amsterdam airport "authorities etched the image of a black housefly into each urinal…[resulting in] reduce[d] spillage by 80 percent"[24] and "by rearranging the cafeteria [designers were] able to increase or decrease the consumption of many food items by as much as 25 percent".[25] Thaler and Sunstein define those who organize "the context in which people make decisions" as "*choice architects*".[26] This is the role of the stakeholders to the RCAF fighter pilot problem as well. The goal is not to impose a policy that forces a standard operating procedure to keep pilots *choosing* to stay in the RCAF, nor is a panel of experts able to define precisely and for all time what are the appropriate steps for retention, instead the situation is a complex eco-system of feedback loops that evolve over time and can be influenced at certain nodes to shift the entire feedback cycle by priming "people into certain forms of behavior".[27] An easy example from figure 1 is the transition from experienced pilots to retiring pilots impacted by multiple negative feedback loops involving the transition from flying airplanes to completing staff tours. This change takes pilots away from what they joined to do (fly), and reduces their pay all at the same time that their prospects in the commercial industry positively explode. Small nudges to the timing of staff jobs, or larger nudges to the pay scale growth rates both are capable of reducing the negative effects of this transition point. Once the confluence of negative effects is found by properly identifying key interactions, any one of those

[24] Thaler and Sunstein, *Nudge*, 15.
[25] Ibid, 14.
[26] Ibid, 15.
[27] Ibid, 77.

interactions can be targeted and resolved as a simple or complicated problem. Critical however is the understanding how this process differs from the reductionist view.

In a reductionist strategy a single interaction is identified then a targeted solution is implemented in isolation. In a complex problem, the same interaction point may be identified using a different type of initial analysis, and the same action may occur at the same interaction point, but prior to implementing the complex problem solver will again look at the first, second and third order effects of the change to see how the proposed action will affect those related factors as well then the solvers may add additional inputs elsewhere in the ecosystem to balance out potential consequences down the line. The paradigm shifts from finding the *right* answer to a complicated problem to finding the *balanced* answer to a complex problem.

In a more prescriptive version, Benjamin and Komlos suggest a ten-step process to "crack complexity" and while this is not the only methodology available to complexity science, it is useful as an initial more linear step to help the CAF transition away from the operational planning process to an alternate method more suited to complex problem contexts. The ten steps include[28]:

- Acknowledge the complexity;
- Construct a really, really good question;
- Target a requisite variety of Solvers;
- Localize the Solvers;
- Eliminate the noise;
- Agree on the right agenda;
- Put people on a collision course;
- Advance iteratively and emergently;
- Change how people interact; and
- Translate clarity and insights into action.

[28] Benjamin and Komlos, *Cracking Complexity*, 8.

The process sounds simple enough but there are many challenges involved in complex problem solving. Even acknowledging the complexity of the problem can be a challenge since it's not just saying the words that the problem is complex, but it is also understanding the implications for the solutions. Specifically, complex problems won't have a single solution, the time to find and implement solutions will remain unknown for some time, and there's no guarantee that the solutions brought to "decision makers" will actually work while in contrast there is a *guarantee* that some, if not many, of those solutions will fail. Short tour lengths, the structure of personnel evaluation reports, and the desire to be seen as "decisive" in the CAF all run counter to the paradigm required to successfully solve complex problems. Using the Fighter Force retention problem as an example, the stakeholder interaction was largely managed on personal time, many iterations occurred in the background prior to the recommendations being brought forward to the chain of command, and even with eventual chain of command support, the implementation has been stymied by cultural momentum that runs counter to the recommendations, the same cultural momentum in fact that is causing many of the negative feedback loops identified in figure 1. This outcome suggests that the institution is not yet ready to accept an alternate problem-solving paradigm and that complex problems will continue to be treated as complicated problems for some time to come. But there remains hope that this could change. There is increasing movement with younger personnel towards complexity, and some in the higher ranks are exploring the roots of innovation that also link to complexity. These two groups are not yet enough to tip the scales fully, but they may be enough to nudge the institution into accepting a new problem-solving methodology for complex problems.

CONCLUSION

The CAF remains unable to solve complex problems because we do not use any of the available methodologies from complexity science in our processes.[29] As Zweibelson notes "[w]e implicitly do this and thus agree as an institution that our military content is less significant than our preferred military form".[30] Zweibelson continues that the operational planning process creates a pseudo-scientific approach entirely in a positivist construct that uses none of the lessons learned in the last few decades through complexity science. Furthermore, the evolution of military thinking to include complexity science is hampered by the knowledge that this mindset shift would "disrupt a significant portion of traditional military education, training, doctrine and schooling".[31] But complexity demands an alternate methodology if the CAF is to see any substantive gains in this area. The example of personnel retention above is but one of many complex issues, the list also includes how we respond to insurgencies, or to operations below the threshold of war, sexual harassment, succession planning among many other personnel and financial problems. The Commander of the Canadian Joint Operations Command has begun an institutional conversation about "How We Fight" in the CAF, but any fight is defined by how we plan, train and equip, which in turn are defined by how we think. Currently, institutionally, we cannot think properly about complexity. Heltberg and Dahl contend that if institutionally we can become more self-aware, we will be able to "instill a cognitive flexibility into our deeply-rooted institutional default modes of thinking" that

[29] Some use of design thinking at the outskirts of CAF thinking is beginning, but it is not yet used in day-to-day decisions or tactical/operational level thinking.

[30] Ben Zweibelson, "Fostering deep insight through substantive play." *Design Thinking: Applications for the Australian Defence Force, Joint Studies Paper Series No. 3*, edited by Aaron P. Jackson (Canberra: ADC Publications, 2019), 115.

[31] Ibid.

will expand our possibilities and increase our potential for "comprehensive and surprising" solutions to emerge.[32]

This institutional transition will not be easy. Grisogono suggests that implementing any new approach within an organisational culture is difficult, but that difficulty grows significantly if the organisation has not yet "learned to value these essential characteristics, which might easily (if superficially) be seen as contrary to traditional doctrine".[33] But the same processes described above can be used to resolve this complex problem of solving complex problems within the CAF as well. Communication in heterogeneous groups, iterations and small nudges can all help transition the CAF into an institution keener and more capable of handling complexity. Finally, it is critical to highlight that a complex problem set does not imply that the solutions are too complex to implement. Simple answers can emerge from a complex problem. As Berlow notes succinctly, "[w]e're discovering in nature that simplicity often lies on the other side of complexity".[34]

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[32] Heltberg and Dahl, *Course of Action Development – Brainstorm or Brickstorm*.
[33] Grisogono, *On the roles of design in Defence*, 86.
[34] Berlow, *Simplifying complexity*.

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