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Joint Operations Headquarters.

SYSTEMIC OPERATIONAL DESIGN: FREEING OPERATIONAL PLANNING FROM THE SHACKLES OF LINEARITY

by Matthew Lauder

Introduction

The Canadian Forces (CF) uses the CF Operational Planning Process (OPP) to design and produce strategic and operational level plans.[1] The OPP is a linear,[2] analytic planning method that is based upon normative/classical approaches[3] to decision-making used for the full range of military operations. The primary purpose of the OPP is to provide the means for a commander to translate strategic goals into a unified plan for military action, and to provide the planning staff with the prescriptive infrastructure to generate and compare multiple Courses of Action (COAs), one of which will be selected by the commander before being developed into an executable plan.

Although employed throughout NATO, the OPP (and similar analytic planning methods, such as the Military Decision Making Process used by the US Army) has been criticized as inefficient and ineffective.[4] Critics argue that analytic planning methods limit the ability of planning staff to understand the highly complex, dynamic, and non-linear problem-spaces that characterize the contemporary operating environment (i.e., insurgencies and humanitarian disasters).[5] Furthermore, critics argue that analytic planning methods are inherently rigid, cumbersome, and time-consuming, and that they unnecessarily restrain participation in the planning process by the commander.[6] Most importantly, critics indicate that an incongruity exists between how the formal planning method is written in doctrine and how it is used in practice, noting that commanders tend to deviate from the formal approach by modifying or eliminating steps.[7, 8] Speaking on the Canadian context, Major L.C. Dalton notes that a "degree of dissatisfaction" exists with the OPP, and asserts that the Canadian Forces may be experiencing a "theoretical crisis" in operational design.[9] Considering these limitations, several theorists and military practitioners conclude that the military requires an alternate planning method, specifically one that supports naturalistic decision-making.[10]

Systemic Operational Design (SOD) has the potential to be one such operational planning method. Developed by the Israeli Defence Force, SOD supports naturalistic decision-making through the use of discourse, iteration, knowledge, experience, and intuition. Although not new, SOD has gained recent attention from segments of the US, Dutch, and Canadian militaries, and it is being touted by some practitioners as an alternative to the OPP.[11, 12] Proponents of SOD argue that it is more effective than the OPP because it is less structured and less time-consuming.

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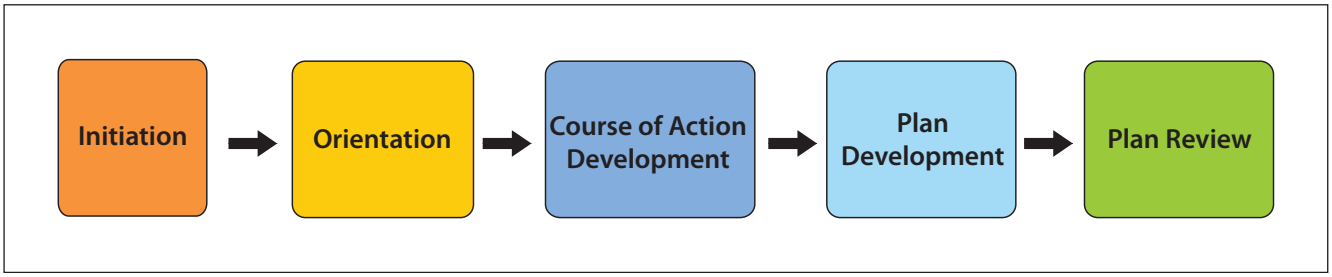


The Operational Planning Process.

Moreover, proponents argue that SOD allows planning staff to more readily integrate new information, modify assumptions, and develop greater shared situational awareness.

This article will argue that SOD is an effective operational planning method, particularly for complex, non-linear environments, and it should be adopted by the Canadian Forces as an alternate to the OPP. To accomplish this task, this article will provide an outline of the two primary approaches to decision-making (i.e. analytic and naturalistic), briefly summarize the limitations of the OPP, and, finally, provide an overview of SOD. It should be noted that, due to space limitations, it is beyond the purview of this brief article to provide an exhaustive analysis of the limitations of the OPP, or a detailed account of SOD.

Analytic versus Naturalistic Approaches

There are two main approaches to decision-making: (1) Classical/Normative models, commonly referred to as *analytic* approaches; and (2) Naturalistic Decision Making approaches, commonly referred to as *naturalistic* approaches.[13] Analytic approaches to decision-making are formalized, highly-structured, and linear, and work by systematically and discretely analyzing information, deducing a conclusion, and then synthesizing the results. Analytic approaches allow military planners to decompose the problem-space into discrete components before synthesizing the results and formulating a response. When used to support the planning process, analytic approaches generally result in the generation and validation of multiple COAs before the optimal COA is selected and developed into a plan. As noted above, the OPP is an analytic approach to decision-making.

The basic principle of naturalistic approaches to decision-making (such as Recognition-Primed Decision Methods)[14] is that they are based on how experts actually think, and reach decisions, in complex and dynamic environments.[15] Naturalistic approaches promote and capitalize on natural thinking and decision-making patterns by utilizing observation, experience, knowledge, and intuition in response to ill-structured, dynamic, quick-tempo, or high-stakes problems.[16] Naturalistic approaches are based upon the notion that it is not feasible to completely quantify the problem-space, and to devise a solution through linear analysis. Unlike analytic approaches to planning, naturalistic approaches allow planning staff to examine the problem-space in a holistic fashion, and then develop and modify a single COA until it is workable. Naturalistic approaches are also iterative, allowing planning staff to 'loop back and forth' through the various steps in order to develop a workable COA. Like the Recognition-Primed Decision (RPD) model, SOD emphasizes the development of greater situational awareness and an understanding of the problem-space for the purpose of generating a single COA, based upon workable criteria.[17]

> **"Analytic approaches allow military planners to decompose the problem-space into discrete components before synthesizing the results and formulating a response."**

An Overview of the Operational Planning Process

The OPP is the standard operational planning model used by the Canadian Forces and NATO for joint operations. The OPP consists of several primary steps (initiation, orientation, course of action development, plan development, and plan review), each of which contains numerous sub-functions. The OPP is commander-led and staff-driven, meaning that the commander provides the overall intent of the mission and the staff generates multiple COAs, from which the most optimal will be selected by the commander.[18] The OPP functions by having the planners, typically grouped in small, relatively independent teams, decompose the problem-space into discrete components, and then sequentially analyze each component and generate and validate a range of COAs. Although formal and linear, the OPP is intended to be iterative, allowing planners to loop back and forth between steps in order to resolve highly complex problems. The OPP is also meant to be flexible in that, while the objectives and the steps of the process remain the same, the commander may exclude or modify planning tasks (i.e. sub-functions of primary steps) in order to meet time constraints.

Criticisms of the Operational Planning Process

The OPP has been criticized as being cumbersome, rigid, and time-consuming. In a comparison of analytic and naturalistic approaches, B. Bergstrand argues that analytic approaches are "excellent theory for deciding on which car to purchase, or where to locate a military unit in peacetime," but they tend to be severely limited when applied to high-tempo and novel operational situations.[19, 20] Based upon his observations of 1 Canadian Mechanized Brigade Group during *Exercise Virtual Ram,* DRDC's Doctor David Bryant similarly concludes that the OPP is "...not ideally suited to military planning," especially in the time-constrained and uncertain environment of warfare.[21] While analytic approaches may be effective in a controlled environment, problem-solving in an applied setting tends to be interactive, iterative, and less linear.[22, 23] In his studies of command and control performance, researcher Gary A. Klein notes that naturalistic approaches to decision-making are more frequently used by experienced planners in highly dynamic situations and when time pressure is the greatest.[24] The result is that military planners tend to deviate from the formal OPP (as it is written in doctrine) in an operational setting, often modifying the process or, in some cases, completely abandoning the OPP in favour of naturalistic approaches.[25]

"A second criticism of the OPP is that it unnecessarily limits participation by the commander in the planning process."

One of the primary criticisms of the OPP is that the process results in the unnecessary expenditure of effort by requiring the generation and evaluation of multiple COAs. Essentially, the OPP requires staff to spend a significant amount of time generating, validating, and comparing a range of initial COAs that will eventually be discarded in favour of a single COA. Critics argue that the generation and evaluation of multiple COAs is a waste of time and effort, especially when there is no support for the notion that the generation of multiple COAs results in a superior COA. For example, Swedish researcher Peter Thunholm notes that selection processes that generate multiple COAs do not yield a better or more effective solution than processes dedicated to the generation and modification of a single COA.[26] Thunholm further notes that the problem-solver typically selects the COA that was first generated, effectively discarding subsequently generated COAs.[27] In a study comparing expert and novice problem-solvers, John F. Schmitt notes that expert problem-solvers typically spend more time assessing and understanding a situation before rapidly developing a COA, whereas novice problem-solvers spend less time understanding the situation and a greater amount of time generating and validating a range of potential COAs.[28] The studies suggest that it is more effective and efficient for problem-solvers to fully appreciate and understand the problem-space and then generate a single COA.

A second criticism of the OPP is that it unnecessarily limits participation by the commander in the planning process.[29] Although the intent of the OPP is to ensure commander involvement throughout the entire process, the formal and linear structure of the process tends to limit participation by the commander. In practice, competing demands severely restrict the ability of the commander to participate in the entire planning process. Simply put, the commander cannot be in all places at all times to support the planning process, and he must pick and choose his involvement. The result is that the various analytical functions, such as COA development, mission analysis, and staff analysis, are performed by the planning staff in relative isolation from the commander.[30] This is particularly problematic, as the commander typically possesses a higher degree of knowledge of the problem-space and the strategic goals, integration of which is essential to effective operational planning.

A related criticism is that the OPP is rigid and cumbersome; that is, the method artificially imposes formal procedures on an otherwise natural approach to planning. The concern is that the formal nature of the OPP encourages planners to view each step of the process as independent and sequential, which implies that each step should be treated as discrete and not used to inform subsequent steps. Although the OPP is intended to be iterative, in practice the process tends to be highly rigid and inflexible. The structure of the OPP forces planners through a series of steps and sub-functions.[31] The OPP is not designed to receive irregular and ad hoc injections of information that require a reconceptualization of the problem-space or modification of assumptions in mid-step, but rather the OPP forces planners to drive towards the end of a step before returning to earlier steps to integrate new information.[32] Davison notes that analytic approaches must come to a complete halt, or problem-solvers must wait until end of a step in order to integrate new information; the result is that the planning process either stalls or planners risk adding the information too late to be of use during that step.[33] Contrary to the OPP's emphasis upon structure and linearity, research indicates that planners do not progress in a sequential fashion through the planning steps. Rather, planners tend to jump back and forth between the steps in order to refine the COA.[34, 35] That is, planners continue to add new information and revise their understanding and appreciation of the problem-space throughout the entire planning process, even while generating a COA or executing the response.

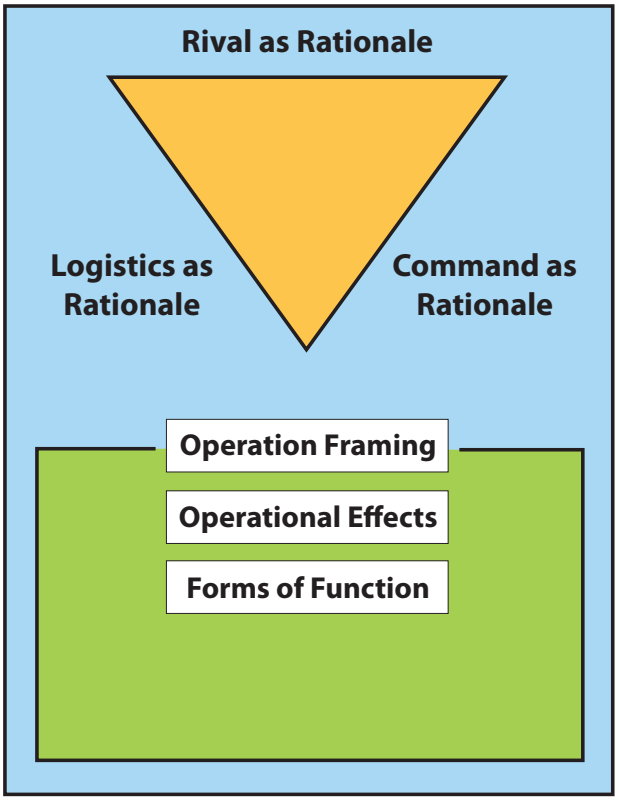
Lastly, the OPP is criticized for creating a false sense of certainty. Analytic approaches are based upon the assumption that the problem-space is closed and readily decomposable. However, warfare is not a closed

system. In fact, war is replete with uncertainty. By listing and considering a range of COAs, the OPP creates a false impression that the battle-space is wholly understood and certain. US researcher R.D. Paz notes that analytic approaches perform "poorly in complex situations" because they are based on the assumption that planners have perfect knowledge and understanding of the situation.[36] Both Dalton and Dixon argue that the OPP typically fails in complex, novel environments because it is designed for more traditional and familiar scenarios, such as large-scale, state-versus-state, mechanized warfare against a known enemy.[37] Dalton further posits that planning staff require a new approach for operational planning because the battle-space is now more convoluted, elaborate, and fragmented than in conflicts.[38]

"Essential in the use of framed discussions is the re-defining of the relationships between the planners, and between the planners and the commander."

An Overview of Systemic Operational Design

Systemic Operational Design (SOD) has the potential to replace the OPP as an operational planning tool for novel, complex problem-spaces. Unlike the OPP, SOD is a highly flexible and iterative planning method. Formally adopted by the Israeli Defence Force in 2000, SOD was developed by Brigadier General (ret'd) Shimon Naveh in response to the paradoxical outcome of the 1973 Arab-Israeli War.[39] Although the Israeli military achieved a great tactical victory over the Arab forces, Israel was defeated on the strategic level.[40] This defeat was attributed to the inability of the IDF to effectively link military tactical-level achievements with strategic goals through the concept of operational art, and Naveh termed this a "cognitive crisis".[41] As a result of this experience, the Israeli military began to question the utility of analytic approaches to planning.[42] In response, the Israeli military started to look for a better and more effective planning method, one which treats the operating environment in a holistic fashion. The search for a new planning method resulted in development of SOD.[43, 44]



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Systemic Operational Design.

The purpose of SOD is to assist commanders to conduct operational planning through the use of systems-thinking (i.e., this approach assists planners to understand the non-linear relationships of the battle-space).[45, 46] Systems-thinking, which is based upon general systems theory and complexity theory,[47] holds that the problem-space is a system comprised of parts, and that each part will act differently when isolated from the system's environment, or from other parts of the system.[48, 49, 50] In particular, systems-thinking examines the interactions between the parts of the system. It is an approach to understanding systems from a broad perspective, rather than merely specific events in the system or parts of the system in isolation. It proposes that the key to understanding systems is the synthesis of elements.[51] Systems-thinking, therefore, addresses the problem-space by identifying and defining the relationships, referred to as tensions, between the various parts of the system. Systems-thinking recognizes that *tensions* are exploitable, and that action to disrupt or influence the tensions will create systemic shock, thus reducing the capabilities (and, therefore, the options) of the opponent.[52]

Over the past decade, the Israeli military has used SOD to understand the complex and dynamic nature of the battle-space and design operational plans, and then coupled this understanding with the use of non-linear swarming techniques (i.e., coordinated activity by separate units operating autonomously, but in general synergy, to achieve a specific end-state) to affect the enemy system.[53]

Discourse as a Framed Discussion

Discourse, which is an institutionalized verbal exchange of ideas, is the cornerstone of SOD. For Naveh, discourse (which I refer to as a *framed* discussion)[54] is used as a means of expressing and organizing knowledge, ideas, and experience. Captured in a rolling narrative or illustration (such as a conceptual map or diagram), the framed discussion is the primary means by which the plan

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Joint operations with Afghan national security forces during Operation *Janubi Tapu* 2, 25 November 2008.

will be conceived and developed; that is, the COA will emerge intuitively through this comprehensive discussion.[55] In total, SOD consists of seven framed discussions, each of which has a specific mandate and goal (that will be discussed later in this article). It is important to note that framed discussions are not merely utilized during the development of the plan, but, rather, are used throughout the entire process, including at the strategic level. For example, the commander will enter into a framed discussion with the strategic sponsor, and, based upon his knowledge of the battle-space as well as the resources at his disposal, will negotiate and define the strategic end-state.[56]

Framed discussions are not simple or concise conversations between a commander and subordinate staff members, but, rather, an extended and comprehensive dialogue, and, most importantly, an egalitarian exchange of ideas and personal experience between the planners. The goal of the framed discussion is to explore the problem-space through supportive group interaction. This does not mean that the group-based discussion is to be mutually affirming or reinforcing. In fact, SOD may be more vulnerable to group-think than other methods because of its emphasis on group-based discussion. Rather, that the framed discussion remains neutral and objective and that participation by all parties is encouraged.[57] However, framed discussion is dialectical in that the planners systematically investigate the nuances of the problem-space, seeking to expose falsehoods and truth through the stages of thesis, anti-thesis, and synthesis. The benefit of this framed discussion is that it creates a common vision of the problem-space, as well as serving as a framework for learning and adaptation by aggregating and transferring collective knowledge.

Essential in the use of framed discussions is the re-defining of the relationships between the planners, and between the planners and the commander. The role of power and politics should not be underestimated in organizations that possess a formal hierarchy, particularly military organizations. There should be little doubt that rank and positional authority have the capacity to restrain free and open dialogue. In order for framed discussion to take place, the relationship between the planners must be qualitatively changed. Specifically, the commander must create and maintain an open and candid, but balanced and democratic, environment.[58] While the commander is not required to lead or facilitate the framed discussion, he must be intimately involved and participate in the planning process. Moreover, the commander must be supportive of divergent ideas, keeping in mind that, within the context of egalitarian discourse, disagreement is not indicative of disloyalty. By supporting diverse input and creating an environment conducive to divergent or novel thinking, the commander can effectively contribute to, and maximize, the creative process.

Iteration

Although SOD is a logical process, where each step is used to inform subsequent steps, the process is not strict or formal. Instead, the process is flexible and allows the planners to return to previous steps in order to integrate new information. SOD is based upon the principle that the problem-space is dynamic and adapts to inputs to the system.[59] J.R. Groen notes that perception of the problem-space is never permanent; rather it is merely a temporary mental construct.[60] To accommodate for this continual state of flux, SOD permits iterations, which allows planners to continuously monitor the problem-space, and loop back and integrate new information without stalling or disrupting the planning process.

Systemic Operational Design as a Process

The SOD planning process is comprised of two distinct phases: (1) *design* and (2) *planning*. The two phases are inherently different, with the design phase concerned with understanding the problem-space, and the planning phase concerned with formalizing action.[61] It is important to note that the design phase is the first phase (i.e., the front end) of the planning process (i.e., it is largely equivalent to the initiation, orientation, and COA development stages, as well as the plan review stage, of the OPP).[62] Essentially, the concept of the plan is developed through a series of design steps before being turned into an executable plan in the planning phase.

The design phase of SOD can be further divided into two main steps, (1) *System Framing* and (2) *Operation Framing,* each of which is divided into multiple sub-functions. The two main steps, and the sub-functions, are referred to as framed discussions. In total, the design phase consists of seven framed discussions, which allows for a holistic articulation of the problem-space and enables detailed planning. Each framed discussion has a specific goal and builds upon previous ones, while serving to inform subsequent framed discussions.

The first framed discussion is that of *System Framing,* which is used to create an understanding of the problem-space in relation to the strategic goal, and consists of identifying and bounding the problem-space (i.e., what has changed that requires intervention) before defining the rival, command, and logistical systems as a rationale. It should be noted that the system boundary is not absolute, and it may be modified as new information is added or as assumptions are modified.

The second framed discussion is that of the *Rival as Rationale,* the purpose of which is to define and describe the rival as a system. Although rival is traditionally thought of as an adversary, SOD intentionally takes a broad perspective in that the rival may be any condition or component, whether friendly or enemy, that is to be disrupted or influenced.[63] It leads to a definition of the rival by examining the logic, motives, intent, behaviours, culture, economics, and interrelationships of the rival with other entities in the system.[64] This

DND photo KA2005-R105-0403d by Corporal Gaétan Racine

definition provides an account of the exploitable tensions within the system.

The third framed discussion is that of *Command as Rationale*. Its goal is to examine the tensions between the current (Blue Force) command structure and the command structure that is likely required by the emerging design. It evaluates if the current command structure is suited for the type of response required, and, if not, leads to the design of a more functional command structure. This is particularly important in a complex environment requiring a multi-national or inter-agency response.

The fourth framed discussion is that of *Logistics as Rationale*. Its purpose is for the planners to examine the existing logistics system and to identify the modifications needed for the system to support the emerging COA. Specifically, this framed discussion examines strategic mobilization and delivery, strategic-operational deployment, and operational-level sustainability in order to ensure that logistics can be delivered in the time and space required. Moreover, it examines whether the logistics system has access to the proper resources and whether troop deployment levels can be maintained for the time required in order to achieve the end-state.

The fifth framed discussion is that of *Operation Framing*. The purpose of operation framing is to narrow the focus of the operation, provide a framework on how to conduct the operation (i.e., to identify the ways and means), establish the temporal and spatial boundaries of the operation, and identify the operational conditions that are to be achieved.

The sixth framed discussion is that of *Operational Effects*. Its purpose is to examine the conditions within the system that, if achieved, will prompt a transformation towards the desired end-state. Herein, planners will analyze the relationship, or required relationships, between blue force and rival forces, and identify the activities that will generate the effects or conditions required to achieve the end-state.[65]

The last framed discussion of the design process is that of *Forms of Function*. Its purpose is to translate the operational logic of effects and conditions into activities, which serves as the basic design for detailed planning. Detailed planning is initiated immediately following the development and evaluation of the COA. It is important to note that only one COA is generated and evaluated during the SOD process, thus saving a tremendous amount of time and effort. If the COA is evaluated as deficient, the last step will be repeated until the COA is satisfactory. As noted above, the detailed planning phase commences immediately following evaluation and acceptance of the COA. In other words, there is no need to wait for the commander to compare and select a COA before engaging in detailed planning.

"The last framed discussion of the design process is that of *Forms of Function*."

Issues with respect to the Use of SOD

There are, however, some concerns regarding the use of SOD. While the process has been used successfully in numerous recent engagements by the Israeli military, particularly the 2002 assault on Nablus and Balata, as well as the 2005 evacuation of settlers from Gaza, it is not currently entrenched in doctrine nor is it accepted as the principal method for operational planning, as IDF commanders have the option of using any planning process. [66, 67] SOD also remains in the exploratory stage in the US and Canadian militaries in that its application is currently limited to table-top exercises. As a result, SOD remains largely an unknown planning approach outside Israel.

Conclusion

The CF Operational Planning Process (OPP) is an analytic planning method used by the Canadian Forces to develop strategic and operational plans. Although in wide use across NATO, the OPP has been criticized as being rigid, cumbersome, time-consuming, and inefficient. Critics argue that the OPP is best suited to familiar problem-spaces, but not for high-tempo, high-risk, and complex scenarios. Critics also argue that there is no benefit to generating and evaluating multiple COAs. Moreover, research reveals that commanders frequently deviate from the formal OPP in operational settings, in particular, scenarios that are ill-structured, high tempo, and high risk. Although the OPP is intended to be flexible, some commanders modify the OPP in order to make it usable in a practical environment. In response to the limitations of the OPP in time-constrained and complex problem-spaces, a number of practitioners and theorists have recommended that the OPP be replaced by a more effective and efficient planning method.

Developed by the Israeli Defence Force, Systemic Operational Design is an operational planning method that overcomes the limitations of the OPP. SOD uses a systems-thinking approach that assists military planners in assessing and understanding the problem-space by identifying and appreciating the tensions of the problem-space. The goal of SOD is to identify these tensions so that they can be exploited, thereby limiting the options and capabilities of the rival. Although proven to be a highly effective planning method in recent Israeli military operations, SOD suffers from a lack of clear doctrine as well as primacy in the Israeli military. In addition, some organizational cultures, especially those with formal hierarchies, may be reluctant to use SOD as it is predicated upon egalitarian discourse and the intimate involvement by senior leadership throughout the entire process. However, the use of egalitarian discourse and the emphasis placed upon commander participation are SOD's greatest assets, as they facilitate a holistic understanding of the theatre of

DND photo AR2008-KO73-31 by Master Corporal Karl McKay

Joint operations with Australian forces during Operation *Timis Preem,* 21 August 2008.

operations and permit the development of a single COA based on intuition and experience. The result is a less-cumbersome, faster, and more responsive and adaptable method that nurtures a greater appreciation and understanding by the planners of the problem-space.

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NOTES

1. For ease of reading, the CF Operational Planning Process will simply be referred to as the Operational Planning Process (OPP). The Operational Planning Process is a standard analytic planning tool utilized by NATO. Although the OPP may differ slightly by branch, either by name or by the numbers of steps (for example, the Land Force OPP has six steps whereas the CF OPP has five steps), the overall function and purpose of the process is the same.
2. Linear refers to the relative chronological order of the various stages of analytical planning methods.
3. Normative, or prescriptive, decision theory is concerned with the identification of an optimal decision or course of action to take in response to a problem. It assumes that the decision-maker is fully informed.
4. Colonel J.K. Greer, "Operational Art for the Objective Force," in *Military Review,* Vol. LXXXII, No. 05, (September-October 2002), p. 25.
5. Linearity implies structural stability and rigidity, and, as a result, a high level of predictability, whereas non-linearity implies instability, fluidity, and unpredictability. The underlying principle of linearity is that the whole is equal to the sum of its parts, which allows the problem-space to be broken down without loss. Within a non-linear environment (in particular social systems), inputs and outputs, as well as the parts of the system, are not proportional. As a result, the parts of the system cannot be isolated from each other or from the system as a whole – the system must be measured holistically. For further reading on non-linearity, please see: T. Czerwinski, *Coping with Bounds: Speculations on Nonlinearity in Military Affairs,* (Washington, DC: DoD Command and Control Research Program, 2003).
6. Greer.
7. Major F.W. Brewster, "Using Tactical Decision Exercises to Study Tactics," in *Military Review.* Vol. LXXXII, No. 06, (November-December 2002), p. 8.
8. D. Bryant, "Can We Streamline Operational Planning?" in *Canadian Military Journal,* Vol. 7, No. 4, (Winter 2006-2007), pp. 84-88.
9. Major L.C. Dalton, "Systemic Operation Design: Epistemological Bumpf or the Way Ahead for Operational Design?" Unpublished manuscript for the School of Advanced Military Studies, United States Army Command and General Staff College. (Fort Leavenworth, KA: 25 May 2006).
10. J. Schmitt and G. Klein, "A Recognition Planning Model," in Proceedings of the 1999 Command and Control Research and Technology Symposium, (Newport, RI: Naval War College), cited in Doctor/Lieutenant Colonel P. Thunholme, "The State of the Art and the State of Practice: A New Model for Tactical Mission Planning for the Swedish Armed Forces.." Paper presented at the 2006 CCRTS. (23 January 2006).
11. Major J.R. Groen, "Systemic Operational Design: Improving Operational Planning for the Netherlands Armed Forces," Unpublished manuscript for the School of Advanced Military Studies, United States Army Command and General Staff College. (Fort Leavenworth, KA: 25 May 2006).
12. Major P.E. McGlade, "Effects-Based Operations versus Systemic Operational Design: Is There A Difference?" Unpublished manuscript for the Air Force Institute of Technology No AFIT/IOA/ENS/06-06, (Wright-Patterson Air Force Base, Ohio: June 2006).
13. Lieutenant Colonel S.L.C. Diggins, "The Estimate and the Emperor's New Clothes," in *The British Army Review,* Number 124, (Spring 2000), p. 5.
14. The Recognition-Primed Decision (RPD) model was developed by Gary A. Klein. RPD is based on observations of decision-makers in operational settings and describes how experts use their experience and personal knowledge to arrive at decisions and without comparative analysis of potential COAs.
15. L. G. Shattuck and N. L. Miller, "Extending Naturalistic Decision Making to Complex Organizations: A Dynamic Model of Situated Cognition," in *Organization Studies* (London: Sage Publications, 2006). Available from <http://www.egosnet.org/os>.
16. G.A. Klein, "A Recognition-Primed Decision (RPD) Model of Rapid Decision Making," in G.A. Klein, J. Orasanu, R. Calderwood, and C.E. Zsambok (eds.), *Decision Making in Action: Models and Methods* (Norwood, NJ: Ablex Publishing, 1993), pp. 138-147.
17. *Ibid.,* p. 7.
18. Department of National Defence, *CF Operational Planning Process* (B-GJ-005-500/FP-000), (Ottawa: Chief of Defence Staff, 11 June 2002), p. 5-2.
19. B. Bergstrand, "Situating the Estimate: Naturalist Decision-making as an Alternative to Analytical Decision-making in the Canadian Forces," (11 May 2001). Available from <http://wps.cfc.dnd.ca/irc/nh/nh9798/0021.html>. Accessed 01 August 2007.
20. Analytic approaches to planning are appropriate for situations where there is ample time to analyze the situation and develop and compare multiple potential COAs.

21. D. Bryant, "Concepts for Intuitive and Abbreviated Planning Procedures." Technical Report 2005-164 DRDC Toronto (Toronto: Defence Research and Development Canada, December 2005).
22. Major K.C. Davison, "Systemic Operational Design (SOD): Gaining and Maintaining the Cognitive Initiative." Unpublished manuscript for the School of Advanced Military Studies, United States Army Command and General Staff College. (Fort Leavenworth, KA: 25 May 2006).
23. Brewster, p. 3.
24. Klein, p. 146.
25. Doctor/Lieutenant Colonel P. Thunholm, "Decision Making Under Time-pressure: To Evaluate or not Evaluate Three Options before the Decision is Made?" In P. Thunholm, "Military Decision Making and Planning: Towards a New Prescriptive Model." Doctoral dissertation given at Stockholm University. (Edsbruk: Akademitryck, 2003).
26. *Ibid.*
27. *Ibid.*
28. J.F. Schmitt, "A Systemic Concept for Operational Design," (2006). Available from <www.mcwl.usmc.mil/schmitt_design_v1_0_with_bibliography.pdf>. Accessed 01 August 2007.
29. In the OPP, certain sub-functions will involve select staff or staff cells working concurrently or in parallel. For example, mission analysis is typically conducted by select senior staff at the same time other planning staff are working on their assigned portions of the plan.
30. Diggins.
31. CF Operational Planning Process.
32. Diggins.
33. Davison.
34. Bryant (2005).
35. M. Kardos and T. Chapman, "Constrained Planning and Wargame Performance in Military and Civilian Teams." (February 2005), DSTO-STO-GD-0352. Accessed from <http://www.dsto.defence.gov.au/corporate/reports/DSTO-GD-0352.pdf>.
36. R.D. Paz, "Visualizing War, Visual Technology and Military Campaign Planning." Unpublished manuscript for the US Army Command and General Staff College. (Fort Leavenworth, KA: 2003).
37. Dalton.
38. *Ibid.*
39. *Ibid.*
40. Groen.
41. S. Naveh, *In Pursuit of Military Excellence: The Evolution of Operational Theory* (London: Frank Cass, 1997), pp. 16-19.
42. Dalton.
43. E. Weizman, "Walking through Walls." Available from <http://eipcp.net/transversal/0507/weizman/> en Accessed 10 August 2007.
44. Groen.
45. McGlade.
46. Effects Based Operations (EBO) is similar to SOD in that it recognizes war as complex, dynamic, and non-linear. EBO attempts to link action and effect in war by adopting a systems approach. It advocates understanding the adversary – in fact, the operating environment as a whole – as a complex adaptive system comprised of several interacting parts (the environment is typical made up of the following parts: political, cultural, technological, military, and economic). For further reading on EBO, please see: Colonel C. King, "Effects Based Operations: Buzzword or Blueprint," in A. English, D. Gosselin, H. Coombs, and L. M. Hickey (eds.), *The Operational Art: Canadian Perspectives, Context and Concepts* (Kingston, ON: Canadian Defence Academy Press, 2005), pp. 313-330.
47. General Systems Theory (GST) was developed by biologist Ludwig von Bertalanffy (1901-1972) in 1936, and can be described as the general science of wholeness. GST holds the following: (1) systems are comprised of parts, (2) the parts have identifiable and common characteristics, attributes, or properties, (3) the parts interact, and (4) systems exist within an environment. In other words, a system is a set of parts that affect one another in an environment. Moreover, GST asserts that a system is characterized by the interactions of its constituent parts and the non-linearity of those interactions. Whereas conventional physics deals with closed systems (i.e., those that are isolated from their environment), GST deals with open systems, which are characterized by continuous inflow and outflow of information or energy. GST holds that a change can be introduced into a system with the specific intent of affecting select parts of the system.

    Complexity Science is the science of non-linear dynamics, investigating how complex systems behave and adapt over time and produce, in certain circumstances, relatively simple and predictable outcomes or results. Complexity lies in the inter-connectivity between the parts of a system and between a system and its environment. Complexity Theory contends that, in order to understand the nature of an open system, one must analyze each individual component in relation to other components (i.e., complexity theory appreciates the interactions between the parts of the system). A principal focus of Complexity Science is complex adaptive systems (CAS), which involve many parts (or agents) acting in parallel in an environment with other parts that are constantly changing. Thus, complex adaptive systems are dynamic and, in fact, self-organizing. These dynamic systems can change over time from within, or in response to, the environment.
48. Dalton.
49. L. von Bertalanffy *General System Theory: Foundations, Developments, Applications* (New York: Braziller, 1968).
50. J. Moffat, *Complexity Theory and Network Centric Warfare.* (Washington, DC: DoD Command and Control Research Program, 2003), pp. 49-51.
51. G. E. Reed, "Leadership and Systems Thinking," in *Defense AT&L* (May-June 2006), pp. 10-13.
52. Naveh., pp. 16-19.
53. Weizman.
54. For the sake of simplicity and accuracy, I use the term *framed discussion* to identify the act of engaging in discourse in the SOD model. The term "framed discussion" implies that the conversation is bounded or has structure or identified limits, even if it appears to be informal or laissez faire.
55. Davison.
56. Groen.
57. As an operational planning tool, SOD involves two cognitive processes: (1) situation assessment, and (2) mental simulation. In essence, people use situation assessment to generate a potential COA and they use mental simulation to evaluate and refine the COA to ensure that it is workable.
58. Major J.A. DiPasquale, "Discourse in Systemic Operational Design." Unpublished manuscript for the School of Advanced Military Studies, United States Army Command and General Staff College (Fort Leavenworth, KA: 22 May 2007).
59. Unlike analytic approaches, which are based upon the assumption that the problem-space is closed and readily decomposable, SOD is based upon the assumption that the problem-space is open and adaptable.
60. Groen.
61. Davison.
62. It is important to note that SOD lacks the overall formality and structure of the OPP. Due to its flexible structure and emphasis upon iteration, SOD tasks equivalent to various stages of the OPP occur earlier, and in parallel to, other tasks in the SOD process.
63. Groen.
64. Future Center US Army Training and Doctrine Command, Concept Development and Experimentation Directorate, *Systemic Operation Design: Designing Campaigns and Operations to Disrupt Rival Systems. Draft Version 3.0.,* (04 April 2005).
65. As previously noted, SOD is similar to Effects Based Operations (EBO) in that operations are planned and adapted based on a holistic understanding of, and systems approach to, the battle-space.
66. Weizman.
67. Groen.