Systems Thinking Leadership

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Fiscal year 2023 marked the deadliest year for Army Aviation in over a decade, with 14 Soldiers killed in 10 separate mishaps. The Army initiated a branch-wide stand-down in April of 2023 to address the alarming increase in mishaps, but as operations resumed, mishaps continued into fiscal year 2024 (Judson, 2024). According to the May additions of Flightfax (2024 & 2025), a total of 23 Soldiers and 1 Border Patrol agent were killed in two years, and Fiscal Year 2025 has already delivered 4 fatalities. These numbers reflect only the mishaps that resulted in the death of crewmembers, while disregarding the additional 237 mishaps (FY23-24) that caused damage exceeding $60,000 (Department of the Army, 2023). The generation of these disturbingly high numbers outside of combat operations has led to official mitigation efforts and informal finger-pointing.

Many are quick to blame the experience vacuum the airline industry has induced across the U.S. military aviation population. In contrast, others point to the UH-72A as the primary trainer for skill degradation. Some feel that the Army's Initial Entry Rotary-wing program is neglecting critical skills. It always seems that the Army's flying hour program is underfunded while operational demand is increasing. From these speculations, it is easy to fall into a linear, event-oriented decision-making process. If we increase the active-duty service obligation (ADSO), we will keep more aviators in the cockpits, leading to a corresponding increase in experience. However, an unexpected trend emerges in the data: the number of Soldiers applying suddenly begins to decrease. Could this be causally linked to the decade's commitment of service in exchange for flight school, which might be considered a side effect? Or is it coincidental? This is a complex problem that requires rigorous study from a complex discipline: systems thinking and systems dynamics modeling.

The world we operate in, domestically and internationally, permissive and nonpermissive, is changing at an accelerated pace. The Russo-Ukrainian War has demonstrated that the challenges our military will encounter in Large-Scale Combat Operations will be even more complex and dynamic. It will neither resemble past engagements nor mirror current combat operations. Many of the decisions we make today will generate unanticipated problems in the future. Mr. Sterman stated in his book Business Dynamics: Systems Thinking and Modeling for a Complex World (2000):

> Effective decision making and learning in a world of growing dynamic complexity requires us to become systems thinkers […] to expand the boundaries of our mental models and develop tools to understand how the structure of complex systems creates their behavior (p. vii).

The Army has started sprinkling the term "systems thinking" in doctrinal publications (ADP), Field manuals (FM), Army Technique Publications (ATP), and various other publications without clearly defining what systems thinking is, beyond a couple of paragraphs, nor has it established a formal block of instruction. A technical report created by the United States Army Research Institute for the Behavioral and Social Sciences (Wisecarver et al., 2022) had "identified systems thinking as one of six strategic thinking competencies" (p. iv). It offered a basic definition of systems thinking: "A cognitive approach that applies a holistic perspective to identify and understand interrelationships and emergent properties among elements" (p. iv). However, the complexity of systems thinking, combined with systems dynamics, will require more than a definition.

The Army will need to cultivate a culture of systems thinking, and that begins with our leaders becoming systems thinkers and understanding the tools available to them for decision-making. The introduction of this concept should be taught at the junior officer level and expanded upon throughout the various levels of professional military education

Systems

Before discussing what systems thinking entails, a system needs to be clearly defined. According to Ms. Meadows' book Thinking in Systems (2008), a system consists of elements that are interconnected to achieve a function or purpose. It is important to note that there is a distinction between the function or purpose and the system's ultimate behavior. Often, the system's behavior is an emergent phenomenon arising from the relationships or interconnections among its elements. The more complex the interconnections are, the more complex the system.

For example, an infantry company is a system composed of elements such as Soldiers, weapons systems, supporting equipment, the environment, and terrain. The interconnections include vertical and horizontal lines of communication, the commander's intent, the laws of war, fields of fire, and the laws of physics. The purpose of the system is to engage and destroy the enemy, occupy terrain, or conduct unit physical training. The behavior of the system could shift due to miscommunication or lack of communication, encountering a steep terrain feature, or even the changing of an element, such as an excellent or toxic leader (Meadows, 2008).

A rifle, such as an M4, is called a weapon system because it consists of elements such as the receiver, the recoil spring, the stock, a barrel, a magazine, the ammunition (which can be further broken down into primer, powder, shell, and bullet), an aiming device, the environment, and the Soldier. Individually, these parts cannot perform a function until they are combined, and interactions are established. These interactions are physical and chemical. The system's function is to accurately shoot a projectile at a target over a certain distance. The behavior of the weapons system can be affected by the type of ammunition, the aiming device, or increasing friction within the system due to carbon buildup. The system's behavior can also be purposely changed by leveraging key points. For the M4, adjusting the barrel length or rifling can affect the weapon system's accuracy and effective range. Changing from iron sights to expensive optics can also affect how the weapon is employed, altering other interactions, such as increased weight, cost, or the life cycle of an element. These changes are the feedback loops that concern a systems thinker.

It is also important to understand that systems are governed by several principles (Shahroudi, 2022), including the holistic principle that complex systems are more than the sum of their elements. An M4 disassembled is no longer a system, nor is it a system without the Soldier. It is the interaction of all the parts that makes it effective in its function. Systems do not exist in isolation; they are part of a larger system that includes themselves (the system of interest), an enabling system, and a context system. The boundaries between these systems may be fluid depending on the perspective of examination, the purpose of the system, and what roles they fill. Systems will evolve over their lifecycles and generate emergent behavior (unanticipated side effects) due to interactions within and between the three systems. Humans are also influenced by assumed mental models of the system's architecture based on its behavior, and the wanted and unwanted emergent behaviors may negatively impact decision-making. A Soldier not correctly trained in maintaining an M4 may have an incorrect mental model of the system and believe that the weapon is broken when it misfeeds a bullet instead of realizing the breakdown is due to his or her inaction.

Systems Thinking and Systems Dynamics

Systems thinking is a term that first appeared in the late 1980s and was soon adopted into the business world vocabulary. In Mr. Schuster's book (2018), he quoted Mr. Richmond (credited with coining the term): "Systems thinking is the art and science of making reliable inferences about behavior by developing an increasingly deep understanding of underlying structure" (p. 8). The ability to think in systems allows for understanding that a system's behavior results from its structure. When outside influences generate a reaction within that system, it will behave in a manner that would most likely be different than that of another system. The solution to a system's problem is usually found by leveraging

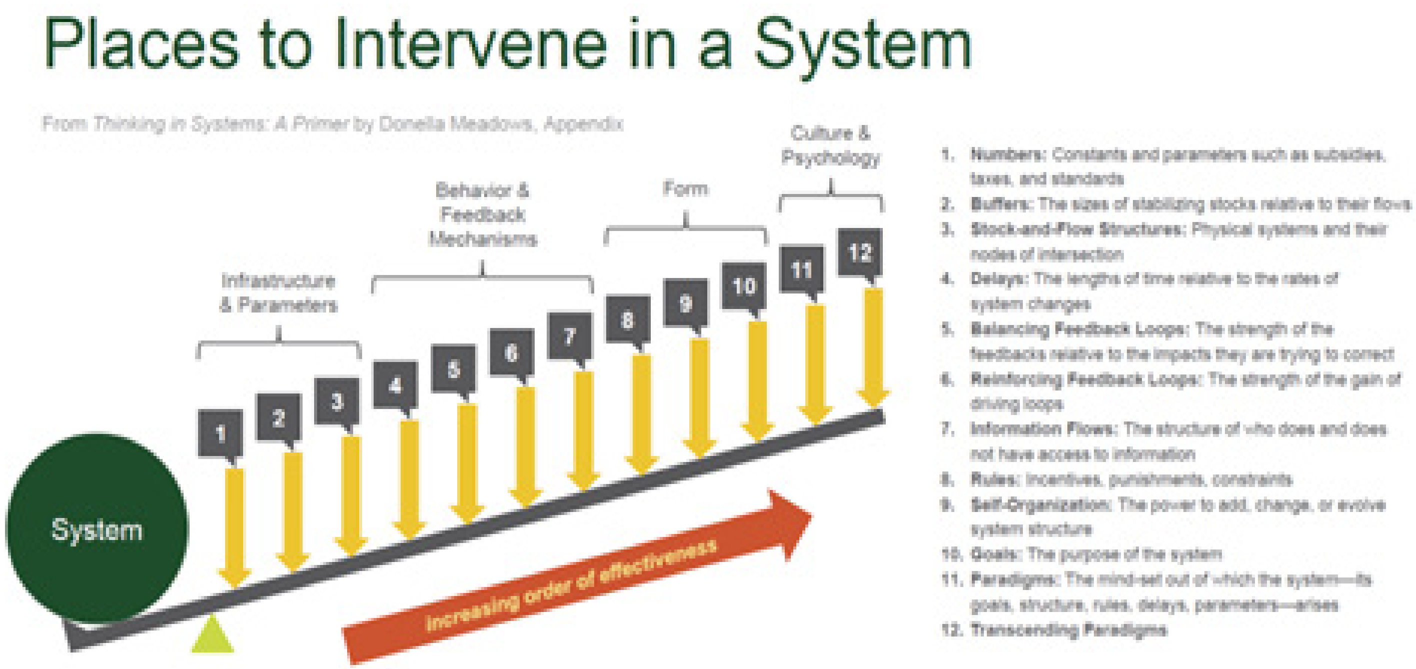

Figure 1 Places to Intervene in a system (Meadows, 2008)

a key point within the system. The challenge is identifying the most effective place to change the system so that the net result of its behavior aligns with its intended purpose.

What systems thinking requires of us is to step back from linear thinking, a methodology we have been taught and used throughout our careers. We have been conditioned to solve problems by analyzing, breaking apart, and then examining the smaller pieces, allowing us to create direct linkages and if/then logic steps, based on a pre-established mental model. It is easy to fall into the trap of zeroing in on an external source, making a decision, and implementing a quick fix to the perceived problem. Although this may yield a solution, it is rarely one that does not generate its own problems. Because of delays within the system's structure, problems may not manifest for a period of time. Our forces have been experiencing significant delays since the DoD shifted to the Blended Retirement System in 2018. There is speculation about the impact the decision will have on recruiting and retention, as well as the level of experience we will maintain within our formations. Seven years later, we still do not have enough data to understand the impacts of the policy change (Seck, 2023).

Systems thinking begins with observing events or gathering data. This information is then combined over a defined amount of time to establish patterns of behavior of how the elements of the system interact. From this, the system's true structure can be established and leverage points identified. The key concept is that the mental model we hold of the system might need to change so we can understand its true structure. This allows us to modify the structure at critical points to create a more holistic solution to long-term problems and minimize unanticipated emergent behavior. Systems thinking emphasizes that, given the complex dynamics of our world, there will never be a perfect solution that does not impact other systems. There is no decision or process that one can affect that will exist in isolation; they will cross boundaries into other systems, and that is where unanticipated emergent behavior will generate.

Systems thinking is a discipline of philosophy that is made rigorous by tools and methods such as causal loop diagrams and System Dynamics simulations. Humans are cognitively limited in the amount of information that they can process. Because of this limitation, the way we perceive data becomes selective, and we make decisions based on a small fraction of available information (Sterman, 2000). In the same way we train our aviators in flight simulators, we can create models of select systems of interest by mapping causal loop diagrams that incorporate the stocks and flows of specific attributes. Computer simulation software will perform calculations over a defined time horizon and generate graphics to inform decisions.

For example, during the COVID pandemic, the term “flattening the curve” was repeated daily across mainstream and social media. This was the result of policymakers reviewing a Systems Dynamics simulation result of how a disease may spread in a population. Figure 2 illustrates a basic causal loop diagram of how the disease spreads. The blue arrows represent interactions or relationships among the different elements, and the blocks represent the two stocks of interest: people who have not had COVID and those who have had COVID. Think of the “Infection Rate” between the two stocks as a valve that controls the flow between them.

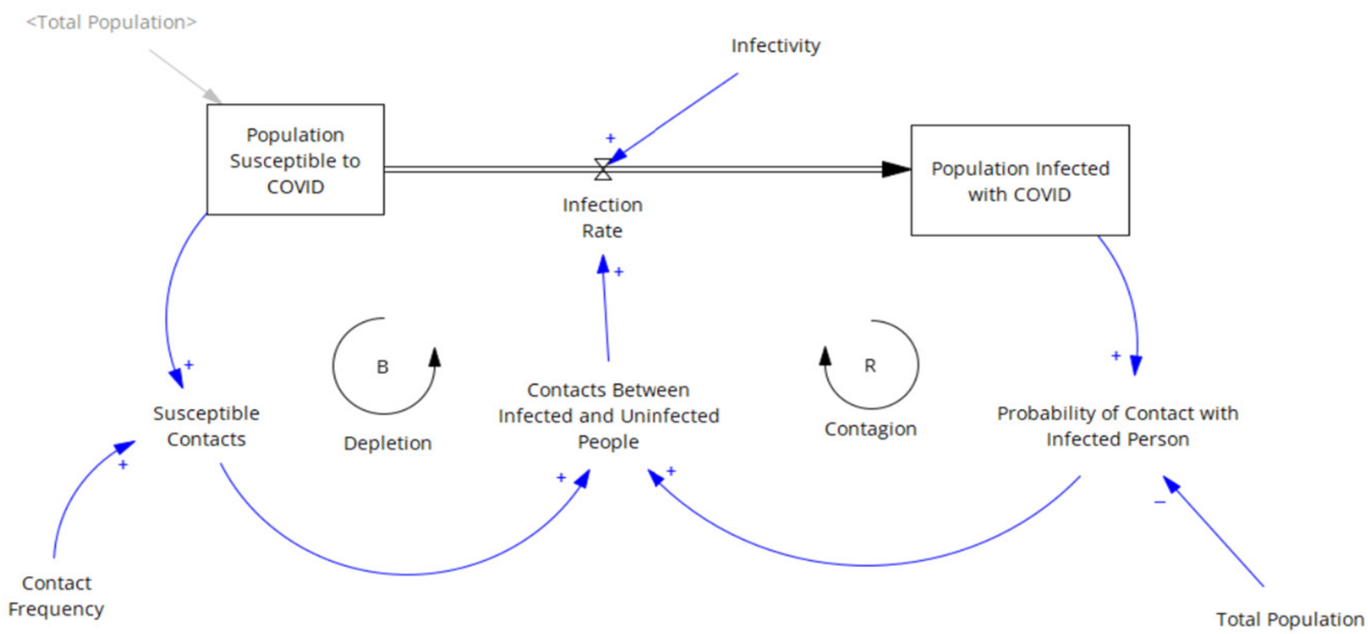

Figure 2 Casual loop diagram with stocks and flows (adapted from Shahroudi, 2022).

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One of the points of leverage within the system that policymakers focused on was the frequency of contact. By reducing contact frequency, government officials observed that the number of COVID cases per day decreased, and a policy for lockdowns and social distancing was developed.

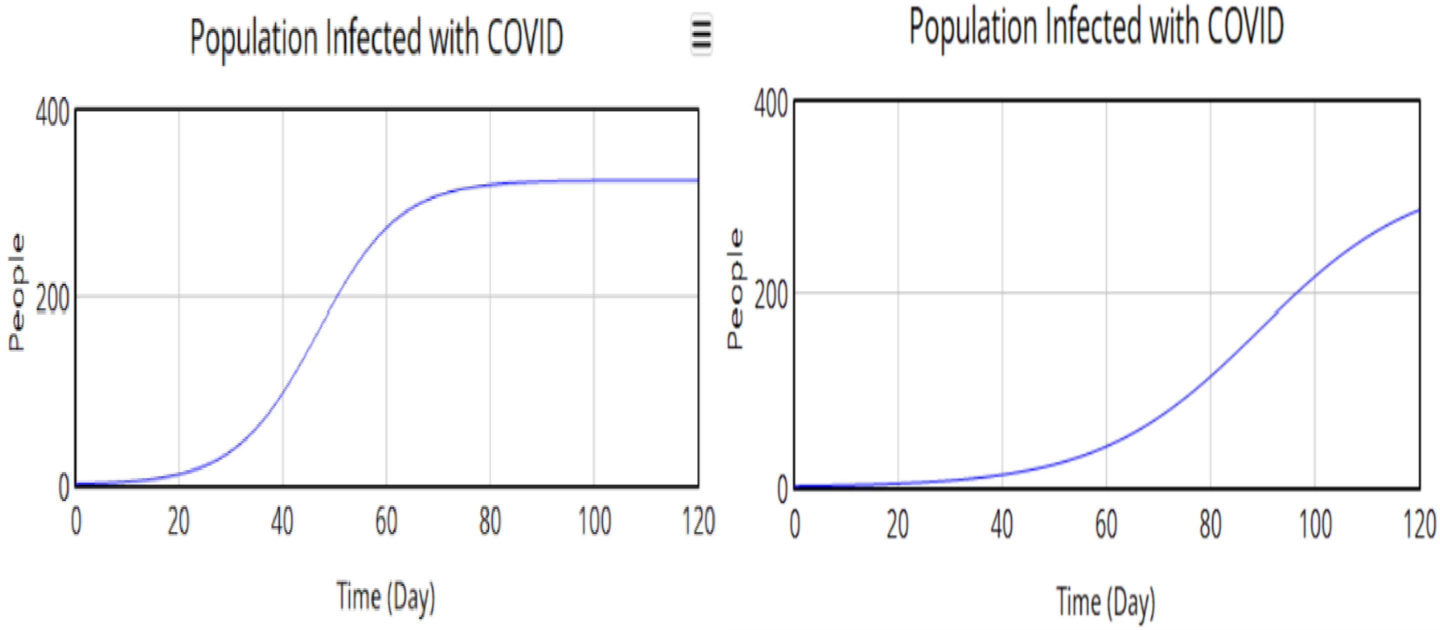

Figure 3 Reducing the Contact Frequency element flattened the curve according to this simulation (adapted from Shahroudi, 2022)

The goal was not to prevent the spread of COVID, but rather to slow the rate of infection to avoid overwhelming the medical system. However, these decisions affected many other systems, including the economy, education, and other key sectors.

The application of system dynamics modeling in our Army is unlimited. These tools can be used to forecast logistics demand, such as oscillations in over- and understocked parts; calculate ammunition forecasts; test the longevity of current production capabilities, as is occurring in the Russo-Ukrainian War; or eliminate costly bubbles in training pipelines. The question of how the Army can improve the proficiency of our new Aviators is complex. However, the answer may lie in a holistic understanding of the system's elements and relationships.

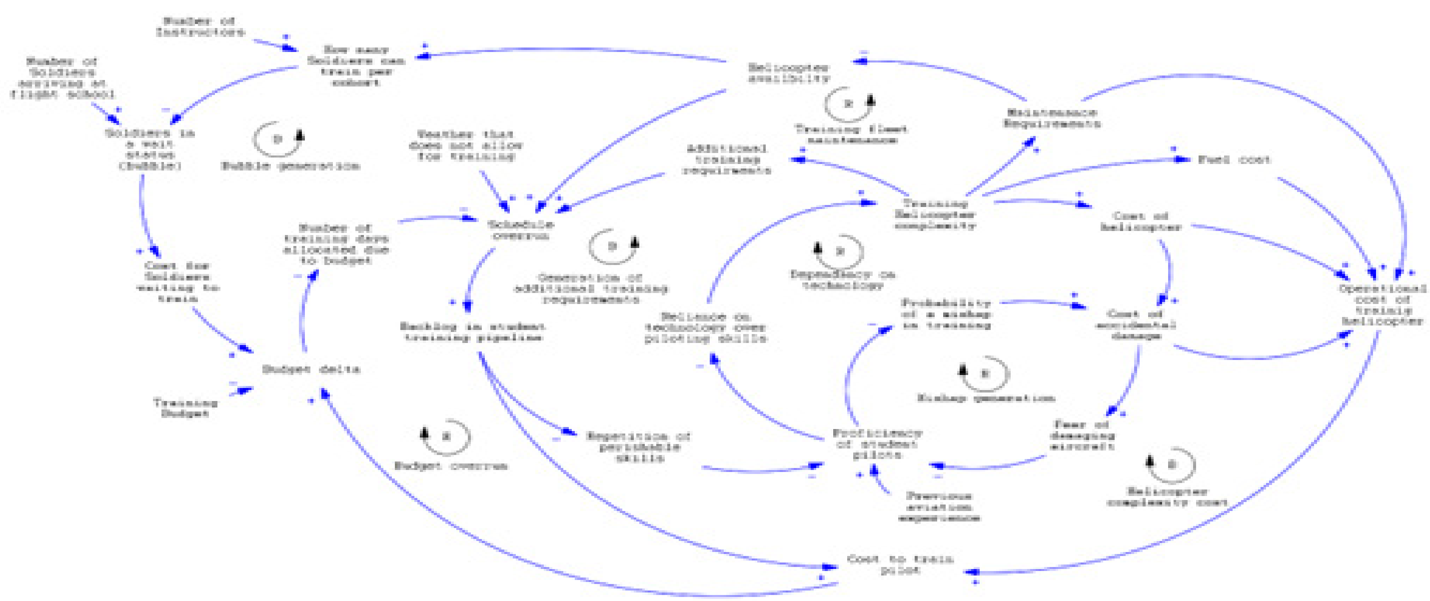

Figure 4 Possible Causal Loop Diagram for IERW, leverage points identified. (Jacobs, 2023)

Conclusions

The shift from a linear thinking model to a systems thinking model will enable leaders at all levels to visualize systems holistically, reveal critical interfaces between elements, and recognize patterns that enable faster, more accurate problem-solving and decision-making. This methodology will increase our readiness for the modern battlefield, thereby reducing casualties from unanticipated consequences.

Educating and ingraining our leaders with systems thinking needs to be done at all levels of command to facilitate horizontal and vertical lines of communication for decision-making. Systems thinking should be integrated at the junior levels of professional military education, and system dynamics should be introduced for select positions at intermediate levels.

The most glaring constant we all recognize about the modern battlefield is how quickly it evolves and adapts. Technological advancements are demonstrating that cheap weapons, such as UAVs, can negate our monetary advantage in expensive weapons systems and technology. The result of this will demand new approaches to defeating our enemies at tactical and strategic levels, faster research and development, a more streamlined acquisition process, and the development of new policies. Above all else, we must do this faster than the enemy.

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