Implementing AI in a Complex Environment: Choking up against fast pitching

In baseball, when you're down by one with two out and a runner on first, you can hit a home run or hit four singles, both to the same net effect. Sometimes its easier not to swing for the fences.

Harnessing the power of Artificial Intelligence (AI) presents a significant opportunity for the US to improve its operations by unbounded quantities in nearly all fields and domains. From developing advanced medical treatments for cancer to optimizing electrical transmission along the national power grid, the national strategic benefits of machine learning and AI are as apparent as they are imaginable. By extension, realizing that AI capabilities provide a strategic benefit to the Department of Defense (DoD) is easily imaginable. It is such a common thought that it serves as a recurring theme throughout popular Sci-Fi culture.

While implementing AI inside the DoD is a simple idea to comprehend in science fiction, developing and implementing such a capability becomes much more difficult in the real world. Broadly, the Army is looking at AI to help solve some of its larger enterprise and operational issues that run the gamut of institutional domains from managing medical data records to monitoring network security and intelligence reporting. From technical perspective, the challenges of large-scale implementation of AI capabilities for the Army are not the hardware or software in which the core AI technology resides. It is, however, in the integration of the raw data required to inform these AI systems and enable them to do their job.

In many cases, the data systems required to be integrated are optimized for different purposes, with different data formats, or in a manner not suitable for sharing among disparate systems. In addition, even though the DoD generates a significant amount of data in a day, the data needed for a specific Army AI application may not exist or is inaccessible, perhaps limited by network bandwidth. While the internet and its military analogs have removed much of the limitations with access to data without it necessarily being physically located in at the point of access, the reality of this system still requires the data to be physically transported, in some form, to its place of use and therefore still bound to the laws of physics. There will still be network capacity limitations for the foreseeable future, so it is in feasible to assume that all data can be accessed sable at all times in all locations.

This paper assumes the data problem is ubiquitous across all potential implementations of AI. Indeed, our data structures (both for analog and digital systems) across the nation over the past 200 years were not built with AI in mind. Additionally, this paper does not advocate against using AI to solve big problem sets of strategic importance to the nation. These are opportunities that need to continue to be explored and developed. Instead, this paper advocates for a different perspective on how we implement AI. The approach that follows simplifies the data problem by shrinking the scope of the system to look at implementations of AI at the individual level. Then, over time, build AI capability upwards, with AI system at the individual level reporting to AI systems at a higher level, who aggregate data and decisions commensurate with their role and authority, and output up or down as necessary for action or decision. In other words, instead of trying to solve the data problem, assume the data problem is immutable and develop the AI architecture around that immutable fact, instead of trying to solve the data problem.

For purposes in this paper, the problem statement for illustrative purposes to develop an operational AI capability that augments the military decision making process at all levels of echelon in order to achieve the national objectives outlined in the National Defense Strategy (NDS). At a first glance, one could make the assessment that a strategic goal like that would require a strategic AI capability and jump directly into developing that capability only to struggle working through the data problem trying to string together all the disparate data sources required.

This paper's approach, however, argues for the opposite. Instead, we first need to develop an AI capability at the lowest level – the individual soldier. For purposes of this illustration I will focus on a specific individual as the starting point, a platoon leader for an Infantry Fighting Vehicle (IFV) platoon. This role represents a balance between operational relevance on the battlefield, level of authority to make decisions, and inherent access to information, while still remaining small enough to act as a starting point. It is worthy to note, however, that this approach is not necessarily specific to that role, echelon, or unit.

Fundamental to this approach is to narrowly scope the function of AI being developed. While a broader discussion of the moral, ethical, and legal implications of using AI in a combat context is being discussed nationally, I feel that the removal of a human from the decision making process in whole is not desirable in the foreseeable future. Our AI exists, not to replace human decision making, but to augment or enhance human decision making. Therefore, decisions are still made within a human's understanding of the moral, ethical, legal context that exists in a specific situation. While this approach may change in the future as machine emotional intelligence progresses enough to make moral and ethical choices, I feel this assumption is safe to follow for the all AI approaches within the current Acquisition ecosystem.

In the platoon leader example, the first question that must be asked is, "How can AI augment the platoon leader's decision making process in order to enable them to make better decisions faster?" Perhaps that answer is through better integration and analysis of vehicle sensor data, or analysis of situational awareness data, or assistance in managing battlefield enablers assigned to the platoon. So in turn, perhaps the AI's role is to identify potential hostiles that pose a threat to the vehicle, or identify gaps in defensive coverage based on the mission, or assist the leader in managing their assigned UAS assets.

The objective, in this first iteration, is develop a bubble of AI-enabled capability around the platoon leader and across all similar platoon leaders in theater. While the bubbles may not interact or share data between each other, the data problem has been limited to just a specific bubble, arguably a much easier problem to solve due to its relative small size (both physically and geographically). However, with multiple bubbles spread throughout the battlefield, the ability for AI to generate positive operational impact increases linearly with each platoon leader placed in the theater. Targeting smaller problems leads to faster implementation and and leverages the high number of systems on the battlefield with a common solution as a multiplier toward combat overmatch advantage.

As time progresses and individual bubbles successfully operate over time, there may be a point where it makes sense to integrate them and share data across them. This approach suggests the platoon leader nodes should be connected to a company level node that does company level processing of data sent from the platoon level, not the development of a new company level node that attempts to integrate all the raw data sources needed from its viewpoint. Similarly, as further echelons are added, higher layers are built from the integration of data from the layers below it. In other words, our AI architecture and data structures should mimic how we already operate as humans, by interacting with the humans lower in the organizational hierarchy, not by reprocessing raw data that someone else already processes. This is evident if the AI's role is to augment, not replace, human decision making.

This approach implies any single AI node, at any layer, has two macro functions: 1) The node must ingest data from whatever node is organizationally adjacent to it (above, below or peer) and understand the data in the native format that it was provided in. 2) The node must process all the ingested data and produce some conclusion that it must output to other adjacent nodes for their use . As tactical level capacities are aggregated higher up in echelon, higher levels become operational capabilities and operational capabilities aggregate to strategic capabilities. The strategic capabilities first mentioned in this example is best built from bottoms-up, not top down.

In conclusion, this paper offers a different approach on how to operationalize AI to achieve strategic objectives. The seemingly obvious answer to a solving a strategic AI problem is with a strategic AI solution. However, a strategic approach overlooks the power of scale offered by implementing small-scale AI capabilities at the lowest levels, then aggregating capabilities over time. Large, strategic level AI capabilities drastically suffer from the data problem, a problem that, at large-scales, is extremely difficult if not impossible to solve. Small-scale AI, working directly with native formats of data sources avoids the data problem and when aggregated at scale can meet the strategic goals desired for the Army, DoD, or the nation as a whole.