**Strategy in the Cyber Era**

Course by

Prof. Eviatar Matania

Final Course Assignment

Lars Maurischat, LTC (DEU AAVN)

**Use of Artificial Intelligence in supporting**

**the military decision-making process**

**Risks and Opportunities**

Decision making processes of all kinds aim to have the best decision in the shortest possible time. In the military domain the decision-making process is designed and structured to enable the decision-making echelon to be proactive and maintain an operational tempo that is enabling decision making with a faster speed and a higher quality then the adversary forces. Operational tempo is the speed and intensity of the own actions taken relative to the speed and intensity of unfolding events in the operational environment. In the military context this is especially challenging, cause the unfolding events are predominantly influenced by the adversary force.[[1]](#footnote-1) [[2]](#footnote-2)

To achieve this military all over have personnel assigned to the decision-making process, usually specially trained personnel, there is a procedure in place that guides or in some militaries dictates the way the decision-making process has to be done, and the decision-making process is supported with respective equipment. The major part of those command and control resources consist in our days of information technology (IT) equipment.

The design of the military decision-making process varies from nation to nation. It is an ongoing structured process of thinking and acting at all military command levels. It is adjusted in content, scope and sequence of the respective situation and the respective task. It is triggered by new tasks or situation developments and takes place in several phases. This structure is the major difference between the different decision-making processes. The phases run as a control loop build on each other echelon and enable consistent thinking and acting.[[3]](#footnote-3)

Even if the phases are different in the different militaries the basic logic is the same. After being trigger the first step is a mission and situation analysis and assessment, followed by a planning step to develop courses of action, next step is issuing orders or commands and the next and last step is control that allows directly the gain of the information needed to restart the cycle as a loop process.[[4]](#footnote-4)

In all this steps information technology is used to enable a high operational tempo. As the military decision-making processes within the different echelons are interconnected. This enables to share information and to get a direct feedback for actions taken. Modern headquarters of all kind are run on the base of computer networks and are interconnected through all the echelons.[[5]](#footnote-5)

To understand how artificial intelligence can or will change these processes it is necessary to understand what is the essence of the concept of artificial intelligence. Artificial intelligence (AI) is a sub-area of computer science that deals with the automation of intelligent behaviour and machine learning.[[6]](#footnote-6) Learning is an integral and dominant part of the artificial intelligence concept.

In general, artificial intelligence refers to the attempt to simulate certain decision-making structures in humans so that it can process problems relatively independently.[[7]](#footnote-7)

Recent development of artificial intelligence has been distinctly. AI systems that use deep learning methods that model the neural processes of the human brain with significant abstraction and simplification have made great advance. Research and development is focusing to enable and improve artificial intelligences ability to learn with limited data for training without supervision and to deal with ambiguous and asymmetrical information. These developments will move artificial intelligence beyond simple calculation and pattern recognition in enormous amounts of data. This fields are traditional the strengths of artificial intelligence.

Most artificial intelligence research is done in sectors that are not explicitly defence related. The capabilities under development, the ability to flexibly categorize information and use it as a basis for decision-making, are valid in the military sphere as well. It is expected that artificial intelligence will be even more useful on all military echelons. Even if the immediate role of artificial intelligence sems to be more tactical, cause the decision-making process on the strategic level is likely to be done under greater uncertainty.[[8]](#footnote-8)

To understand the near-term changes, it is important to realise that artificial intelligence is already military reality. A lot of weapon control systems make their decisions independent of additional input. And the already described strength of analysing big amount of data and identify patterns is used especially in the intelligence branches all over the world.

Further changes are under development. This will enable artificial intelligence to autonomous decision-making by networked computer agents and will enable extremely fast sequential actions even in unsafe operating environments. It will enable conclusions within uncertainty and based on confused data. This artificial intelligence learns by examining past actions or by observing the parallel actions of other parties. Deep learning algorithms can already do this, and some have mastered the first principles of complex control challenges. New techniques can be even more efficient and include the ability to learn concepts and relationships from smaller samples than those involved in the lengthy training processes that are typical of deep learning today. This will enable autonomous and intelligent platforms to manoeuvre faster and use force more precisely than humans. An artificial intelligence system can already outperform an experienced military pilot in simulated air-to-air dogfight. Artificial intelligence will change other military activities such as logistics, intelligence and surveillance. Military who can successfully develop and deploy them will experience a dramatic increase in combat strength compared to those who cannot.[[9]](#footnote-9)

Artificial intelligence might change strategies by providing insights based on processing large amount of data and identify centre of gravity and key vulnerabilities within hostile forces. By using artificial intelligence within the decision-making process, the human error can be minimized by excluding group thinking, confirmation bias, bureaucratic politics, excessive optimism and poor risk assessment.[[10]](#footnote-10)

Many relevant artificial intelligence technologies are not yet mature. Modern unmanned aerial vehicles can operate autonomously, but cannot yet perform the complex missions that manned equivalents can achieve. Sceptics rightly point to the earlier enthusiasm for AI, followed by disappointment and stagnation, since concepts do not make any major breakthroughs in autonomous decision-making. There is considerable concern that the hype and reach associated with deep learning will not lead to dramatic breakthroughs in knowledge that could approach human-level skills - such as satisfaction between conflicting goals or flexible use of imagination and memory for coping with new scenarios. However, rapid advances in artificial intelligence research that is using multiple techniques and increasingly powerful hardware for executing algorithms, suggest that artificial intelligence can have a significant impact on existing military activities in the short to medium term.[[11]](#footnote-11)

An important difference is the extent to which an artificial intelligence is either directed or autonomous at the motivational level. An artificial intelligence whose activities are entirely driven by human principles and which accurately anticipate and implement its intentions is less worrying than one that delivers unexpected results. Either because the intent has been poorly specified or because the artificial intelligence has its own subordinate motivations in one developed and followed the efforts to meet them. Modern artificial intelligence is faithfully trying to maximize its reward function.[[12]](#footnote-12)

But modern artificial intelligence makes radical, unexpected, and overall inhumane movements, and versions of military artificial intelligence can do the same. The inner logic of an artificial neural network is currently something like a black box.

Artificial intelligence will change the power balance. It will improve the military's ability to detect, manoeuvre before concentrating their powers and triggering precision fires. This will change the utility of force by enhancing lethality and reducing risk for militaries possessing those systems.

A small technological advantage in AI is likely to have a disproportionate impact on the battlefield. Since small advantages in decision making, especially in terms of speed and exactness, speeding op the operational tempo, can disproportionately lead to dominance.

There are some key technical barriers for entry that specific difficult levels of innovation. This should benefit existing advanced industrial nations in this field. Those nations will strengthen their military power compared to others, far beyond the improvements already achieved through the information revolution in military affairs.[[13]](#footnote-13)

The most relevant distinction will be between the best algorithm and the rest. This is because the marginal quality could prove to be absolutely critical. If other things are the same, we can expect a higher quality artificial intelligence to completely defeat inferior rivals.

This development doesn't have to be linear. Specific optimizations that generate a temporary advantage do not necessarily prevent the emergence of better alternative approaches. However, if this optimization is sufficiently advanced, it can outperform all others significantly enough to hinder other approaches.[[14]](#footnote-14)

Artificial intelligence might favour the offensive side because of its speed, precision and acquisition and analysis of unbiased knowledge. While such attributes can equally be used by the military on the defensive, there are important aspects in which the AI shifts the balance. The most obvious is that by definition, the offense is the initiative, and with mature artificial intelligence, this alone could be enough to overwhelm the defense.

Following Clausewitz’s explanation about the peak of the attack and the relative strength of the defense, might predict that while human decision makers tend to be loss-averse an artificial intelligence driven decision making might tend to be not vulnerable to these human tendencies. An artificial intelligence might be willing to take a greater risk.[[15]](#footnote-15) [[16]](#footnote-16)

Artificial intelligence will shape military activity across a wide range. When the benefits of artificial intelligence are speed and decentralized control, this dynamic is dangerous and requires human supervision to watch the aim closely. To make it even more complicated, artificial intelligence might not only be used to apply forces, but also to other military processes, like logistics, weapon design and human resources, to name just a few.

To position themselves as a nation capable of using artificial intelligence in the described manner and to the desired level, there are key elements that have to be present.

First, there has to be a large pool of the right type of data. The most powerful machine learning techniques, such as deep learning, need a large amount of data to achieve high performance. Companies with large amounts of data therefore have the advantage of developing superior artificial intelligence. This will favour those nations that will be able to identify and acquire large data pools of high military importance in order to develop high performance artificial intelligence systems.

Beside the data the human resource is crucial. The skills required to develop advanced artificial intelligence systems are limited. Nations that develop education, training and immigration policies to recruit and train top talent from their country and others will have an advantage over others.

Machine learning requires extensive computing power resources, especially for artificial intelligence training. Beside the fact that this is cost expensive it requires access to certain high technologies. Militaries that have greater resources will have an advantage in building high class artificial intelligence systems.

Those militaries how will be able to enable this development requirements will be superior in the development of artificial intelligent systems. And will be able to outperform adversaries in the field of artificial intelligence. By doing so, they will also be able to significantly increase their operational tempo by using artificial intelligence systems in the decision making to eliminate mistakes and fasten the process. This will enable those nations to achieve superior command and control capabilities.

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Nice work.

The analysis overlooks a major threat presented by deploynemt of AI systems and that it is the danger that they would be manipulated through cyber attacks (on the data, the training, the algorithm itself, in the field, etc.)

Providing examples to the arguments presented in the paper would have strengthen and sharpened them.

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