The Application of Artificial Intelligence in Operations Planning

Kathleen McKendrick
COE-DAT
TURKEY

mckendrick.kathleen@gmail.com

ABSTRACT

Much military Artificial Intelligence research and development funding is targeted at improvements to tactical level systems which are realisable in the short term.[i] *Here, the potential benefits of Artificial Intelligence (AI) are often limited by the quality of sensory inputs and the ability of machines to interpret them. However, to fully understand the implications of AI in warfare, there is a need to envision its application in a future battlefield where sensors and inputs are optimised for machine interpretation. We must also try to understand how artificial intelligence will be qualitatively as well as quantitatively different to ours. This paper presents the potential for both automation and autonomous machine decision-making in the Comprehensive Operations Planning Process. It argues that the most significant latent potential of AI may be at the operational and strategic, rather than the tactical, level. The implications of increased machine involvement in high level military decision making are then explored, highlighting the potential and some of the risks. The development of Artificial Intelligence for application in these circumstances should be characterised as an arms race we cannot afford to lose, but that we must undertake with the greatest of care.*

1.0 INTRODUCTION

Currently, civilian development of Artificial Intelligence (AI) vastly outstrips its application for military purposes.[ii] Defence is, as yet, relatively insulated from the disruptive change of new social technologies and despite the understanding that cyber will be an important future domain, not yet accustomed to a digital-physical hybrid world.[iii] Efforts to employ AI in the military tend to focus on tactical applications.[iv] However, benefits of AI in these areas are limited by input sensors, their employment to replicate human behaviour and use in a role where they are required to interact with the physical environment. At the operational and strategic level, military headquarters are characterised by information flow in and out. These products, nowadays, are invariably entirely digital. Considering the operations planning process shows that a high proportion of it could be feasibly automated, even at current technology levels. Much of this automation does not constitute AI in the purest sense which it may be understood, that of 'machine intellects that have enough general intelligence to substitute for humans across the board.'[v] However, the fact that software can out-perform humans at specific tasks, coupled with the fact that the high-level military decision making process is broken down into just such specific tasks, makes it a useful vehicle to compare the merits, limitations and capacities of human and machine decision-making. Doing so, it seems possible that human ability might be easily superseded. Thus, the motivation to pursue automation of military decision making is certainly present. This paper discusses the potential and practicalities of partially-automated military decision making and imagines some of the possible risks and implications of unrestrained AI development for these purposes.

2.0 LITERATURE REVIEW

Numerous studies exist concerning the application of AI to autonomous weapons systems, particularly exploring the legal and ethical implications of such.[vi] Recent examples of papers which take a more broad approach to understanding the implications of artificial intelligence to warfare and defence include Mary Cummings, writing ‘Artificial Intelligence and the Future of Warfare’ for Chatham House[vii] in January this year and De Speigeleire, Mattijs and Sweiejs, examining ‘Artificial Intelligence and the future of Defence’ for the Hague Centre for Strategic Studies in May.[viii] Cummings adopts a more traditional approach and focusses her study in large part on the well-trodden ground of autonomous weapons systems. She cites technical immaturity of autonomous systems, particularly their inability to replicate knowledge or expertise based reasoning, and a lack of spending in the defence and aerospace sector, as limiting the implication and application of artificial intelligence in war. Further, she argues that organisational and cultural barriers to the adoption of full autonomous systems will perpetuate the current situation.

De Speigeleire and Sweiejs take a vastly more revolutionary approach. They argue that AI will represent a paradigm shift, not only for defence, but for what they refer to as the ‘defence ecosystem,’ a broad concept incorporating the foundations on which defence is built. The relationship between government, military and the population will no longer be the golden triangle upon which our understanding of warfare should be hung. The authors question the assumption that the advent of artificial intelligence will allow warfare to continue along much the same lines as it always has, with humans meting out physical violence through the deployment of increasingly clever projectiles.[ix] De Speigeleire and Sweiejs visionary future may be at some point be realised, but until then it is almost certain that humankind’s innate predisposition to politicised violence will guarantee a period of transition where AI supports warfare close to the way we already know it.

Whilst there is a body of work about the application of AI to warfare and even strategy, it is limited compared to the vast resources either on AI itself or on military decision-making and strategy in general. It is interesting to chart relevant developments in military thought alongside the progress of AI research and development.

A revolution in military affairs is a theoretical concept describing the disruptive impact of technological developments on the way warfare is conducted.[x] Historian’s subscribing to the idea of revolutions in military affairs vary in their opinions of exactly how many there are. Some maintain there have been only three, reflecting major social changes: the agricultural, industrial and information revolutions. Others contend that the advent of gunpowder in military use, the atom bomb and the development of airpower, amongst others, also qualify. Coinciding roughly with emergence from the depths of the ‘second AI winter’ 1987-1993, the information-based revolution in military affairs was explicated specifically by Norman Davis in 1996.[xi] Before this point, the technological superiority of coalition forces and their use of precision strike in the first gulf war was already being held up as an example of such a revolution. The information-based revolution in military affairs is widely held to be on-going, rather than complete, and its implications are contested and remain to be understood.

Building on the idea of an information-based revolution in military affairs, the much maligned[xii] concept of Network Centric Warfare appeared in 1999.[xiii] As victory continues to elude coalition forces in Afghanistan and is contested in Iraq, the idea of Full Spectrum Dominance as a campaign-winning strategy[xiv] has been called into question. This is particularly true in the information space, where the hearts and minds of locals proved less susceptible than expected to influence operations. There may be a tendency to conflate these still very recent ideas of information superiority with the implications of even newer developments in Artificial Intelligence. The result of this is to denigrate the latter by association. The employment of AI does not necessarily depend on fully understanding or dominating a contested information space, rather it accepts conditions of uncertainty and offers the potential to make better decisions under those circumstances. A distinction between these two approaches is drawn in the Chinese concepts of ‘Informationized’ as opposed to ‘Intelligencized’ warfare,[xv] although there remains to be a Western equivalent gaining as much traction.

Albeit for different reasons, De Speigeleire and Sweiejs, considering the implications of Artificial Intelligence for defence, are not the first to question continued applicability of Clauswitzian state-centric warfare conducted for the rational purpose of furthering political ends. Kaldor in ‘News Wars’[xvi] and Van

Creveld in ‘The Transformation of War’[xvii] both did so in the early 1990s, citing a new cast of involved actors and a move away from the idea of a nation-states’ monopoly on legitimate use of violence. Building on this school of thought, British General Rupert Smith described future wars as being ‘amongst the people.’[xviii] The much contested concept of fourth generation warfare characterised insurgent adversaries as a new development which represents a generational shift in the character of war.[xix] These theorists represent a parallel line of thought development, characterising war in the future as low-tech, less rational and likely to feature asymmetric adversaries. It is not reasonable to assume that these trends, however accurately perceived, will render developments in AI as irrelevant to the future conduct of war. Instead, recent campaigns against low-tech adversaries in Iraq and Afghanistan have brought into focus vulnerabilities of the Western military machine and the fragility of technological superiority in the face of a complex operating environment.

Pankhurst distinguishes Artificial Intelligence as representing the Fifth Generation of Warfare, but he maybe understating the implications of AI in doing so.[xx] There has been a clamour of suggestions about what the fifth generation of warfare maybe. Russian scholars appropriate the term to classify foreign interference to cause social, economic and political disruption with the final end state of regime change, amusingly parallel to the Western idea of Hybrid war.[xxi]

Military bloggers have also treated the issue of Artificial Intelligence’s potential as a revolutionary force in warfare, with the contributions of Cruz,[xxii] Elkus[xxiii] and Lewis[xxiv] being most directly relevant to this particular study.

Writing specifically on Artifical Intelligence and strategy, Drs Kareem Ayoub and Kenneth Payne argue in the Journal of Strategic Studies that the main impact of AI will be tactical, and that the ability to derive high-level strategy requires a creativity which, for now, is well beyond the capabilities of AI.[xxv]

3.0 AUTOMATING THE OPERATIONS PLANNING PROCESS

During this section the planning process for the operational level is used as a lens to examine how much of military high-level decision-making can uniquely be conducted by humans, and to consider how far this is likely to endure. The operational level concerns all activity in a specified, campaign specific, geographically defined 'joint operations area.' At this level the operational commander interfaces with the strategic commander, both of whom are military. The strategic commander interfaces with politicians, or in the case of NATO, diplomats representing politicians. Below the operational commander a number of tactical and functional commands are responsible for the delivery of aspects of the operational commander’s plan. Thus, the operational level represents one of the highest levels of military decision making.

There are various military decision-making models. These include the United Kingdom’s 6-Step estimate, used at the operational level and the abbreviated 7 question estimate for smaller formations. The United States of America uses the seven-step Joint Operations Planning Process in contexts where more than one service is involved. This largely replicates the Army’s Military Decision Making Process, but also parallels the Marine Corps Planning Process. Western approaches such as these are synthesised in the Comprehensive Operations Planning Process adopted by NATO, detailed in the Comprehensive Operations Planning Directive (COPD)[xxvi] and used for the purposes of analysis in this paper. All of these models are characterised by effort to develop what is referred to as an ‘operational appreciation,’ that is shared awareness and understanding of the problem, and then to build on this with the conduct of an 'operational estimate,' a methodology for solving the problem.

The COPD ‘outline(s) the military procedures and responsibilities governing the preparation, approval, implementation and review of operation plans.’ As such the directive 'enables a common approach to operations planning.'[xxvii] This approach, alongside that of related military decision-making processes, has been criticised as being unduly linear and mechanistic. Such processes provide a framework whereby a problem which is complex, warfare, can be approached as if it were complicated. It is this very characteristic, that of a mechanised approach, broken down into discreet phases and steps, which makes operations planning highly susceptible to automation.

Already, significant aspects of military planning are supported by automated decision-making support. It is left to appraise what would remain of the process, or more specifically, how far the process would remain human, were this to be extended. Analysing the phases in detail shows some examples where logical reasoning could be coded to allow automated conduct. A significant number of these parts of the process are already exploited with operations planning tools such as Tools for Operations Planning Functional Area Services (TOPFAS). There are other parts of the process where more sophisticated levels of autonomy could be achieved with current technology used in civilian sectors: the derivation of operational actions from effects, for example, could be supported by advances in natural language programming. There are further examples where autonomous conduct of a particular step in the process might feasibly be supported by future developments. For example, improvements in probabilistic decision making could facilitate the selection of a limited number of potential courses of action for deeper analysis. Better systemic models could support numerous stages of the process, not least significant actor analysis and war-gaming. There are outstanding parts of the process which rely on humans for their conduct. An example is the specification by the Operational Commander of course of action assessment criteria. These are likely to remain so, unless (or until) the process itself is changed to facilitate a higher degree of automation.

The 6 phases were considered as 50 sub-phases which further broke down into 238 actions. Whilst considering the phases was a useful approach to analysis, the deductions and observations are summarised below against the more meaningful outputs and purposes of the operations planning process.

3.1 Developing and Maintaining an Appreciation of the Operational Environment in a potential or actual Operations Area

'Coherence in the planning and conduct of operations requires building/fostering a shared comprehensive understanding of the situation from the very beginning of planning and maintaining this understanding throughout the process.'[xxviii] Advances in data analytics have significant implications for the operational appreciation that is the foundation of the operations planning process.

Horizion scanning is likely to be improved by automated data collection against key indicators. Currently NATO Intelligence and Warning System (NIWS) is reliant on critical factor identification based on human expert knowledge, this could be augmented, if not replaced by more sophisticated quantitative tools. Contemporary computational capability could allow the incorporation of multiple sources of information, for example discourse analysis of publically released political statements, media and social media, the monitoring of environmental trends which potentially precipitate humanitarian disaster, records of cyber aggression, economic indicators and political events. These data inputs could be collated to give algorithmically derived risk levels. Civilian sector equivalents, both in defence and wider industry give a glimpse of the potential in this area. De Speigelaire et al describe google search as 'the single largest (fastest and accelerating) learner about humanity and its environment in all of its aspects.'[xxix]

Data permanence and availability means that the algorithms behind this analysis can be continuously improved, adjusted to regional circumstances and tested against both crises that break out and those that diffuse. The result could be a greater than human level of situational awareness. Human situational awareness in this context is commonly made by observation of a number of factors and qualitative deductions made based on them. It is as much the process of doing this, rather than just the deductions themselves, which contributes to situational awareness. Thus, much understanding is lost when it is handed over between units or individuals. Initial employment may see this improved operational appreciation simplified to a level where it can be absorbed by humans. In the short term, this is a problem of effective data management. Mastering it would have the potential to improve mission hand off and contribute to inter-human understanding. A simple first stage of this would be through allowing all information presented to be easily interrogated further. Deeper automation may see this more sophisticated operational appreciation directly informing machine decision-making later in the operational estimate process.

3.2 Contributing to the development of strategic military response options within a comprehensive approach

There are specific areas on which operational advice on the strategic military response options is likely to focus. Some of these, for example, legal considerations, might be considered to be computable based on civilian examples.[xxx] Picking the most appropriate rules of engagement from a limited range of options is within the bounds of possibility. Others, such as the interest and engagement of actors[xxxi] or the position of the world media, could certainly be supported by improved data analytics.

The quality of operational advice provided on the strategic military response options depends on the understanding developed in the operational appreciation described above. In military usage, the verb 'appreciate' means something along the lines of ‘understand in depth and conceive the full implications of.’ Whilst automating parts of the operations planning process allows significantly improved organisation, analysis and presentation of data, an autonomous system doing this cannot be said to genuinely understand the information it is processing without significant advances in contextual adaptation. Despite this, clever programing in the short term could bypass the need to understand and allow the key implications of certain factors to be identified against known likely risks to military operations. For example, an operational risk might arise from tenuous supply lines of communication into an area of operations or from fractious relations between coalition allies. Which of these circumstances is relevant could be easily deduced from the data already collected as part of the ongoing operational appreciation.

A crucial part of the operational advice on the military response options is an assessment of their feasibility. Here automated decision support might give far superior answers than human estimation alone, especially when assessing feasibility in terms of troop, capability and sustainment requirements, rather than the slightly more ethereal political considerations.

3.3 The operational mission and its essential Operational Actions

Advances in Natural Language Processing allow a mission to be meaningfully interpreted by a computer, especially due to the use of a restricted pool of mission verbs with very specific meanings.

Understanding the operational actions which support the achievement of the mission is dependent on recognising which behaviours and circumstances must be changed to meet it. This might be successfully routed in systemic models of the behaviour of actors involved. In terms of changing behaviours, analysis of the actions of actors involved could be used to deduce their motivations and most appropriate lever of influence. At the moment, understanding of the adversary is invariably susceptible to the projection of ideas belonging to human analysts themselves. Rather than simply informing the early stages of operational appreciation and then being discarded, these systemic models could be retained and improved as the campaign develops.

3.4 Designing the operation in terms of Operational Objectives, Lines of Operation, Decisive Conditions and Operational Effects

Computational power allows for more detailed consideration of multiple courses of action. Perhaps, applying a morphological analysis, all feasible possibilities could come under some form of consideration. It is difficult to see what would distinguish this as inferior to any notions of human creativity, insofar as it is applied at the operational level.

Importing the systemic analysis from the previous phase of the process would also make it possible to test these courses of action against a credibly modelled adversary. Ability to consider, play out and reconsider numerous strategies in a comparatively short space of time might shortcut the evolution of a usable expertise. Certainly there would be potential for working credible enemy actions into the plan, especially as they adjust to friendly actions. For example, separate courses of action are currently tested against the same 'enemy most likely and most dangerous course of action,' whilst in reality, this enemy course of action is likely to be adjusted based, at least in part, on the actions of the military force making the plan. This reality is currently addressed through the war-gaming process, but increased autonomy would allow this to occur more fluidly and at an earlier stage in the process.

A project called 'Deep Green' explored the possibility of technical support to this phase of the decision making process, albeit at the tactical level.[xxxii] Like the Deep Blue program to which it plays homage in its name, this program is based on exhaustive enumeration of possibilities. New technology, such as that supporting the success of the Deep Mind program at the game GO,[xxxiii] makes possible the evaluation of a vastly higher number of possible outcomes probabilistically and might be particularly applicable for higher level decision making.

3.5 Activating and preparing the required forces for deployment

The later stages of operational planning are already automated to a significant degree. Civilian examples abound of the effective application of intelligence in the form of smart logistics and the DAPRA funded Advanced Logistics Program, said to justify the entire budget of Defence spending on AI in savings made by that single platform. Autonomous support to force generation could be extended to application of tailored training and equipment derived from mission sets, linked with understanding of operational action verbs, and modified based on knowledge of the operational area linked with the understanding of action verbs associated with operational actions.

3.6 Directing the synchronisation of joint and combined operations in co-operation with non-military and other non-NATO efforts

The allocation of assets to tasks and the synchronisation and de-confliction of their actions is an example of something which is onerous for people, but easy for computers. Further, human planners focus on synchronising actions in time and space. Automated support to this process could extend this de-confliction across the electromagnetic spectrum and also build in consideration of the cumulative influence effects activities have in the information space.

Capacity to monitor results and activity could allow the construction of more intelligent feedback mechanisms. This in turn would mean that nuanced alterations to sequential, conditions dependent, actions could be made. Extending this to its logical conclusion, the detail of the plan could be almost entirely flexible, adapting to find the best way of meeting the higher strategic purpose as conditions change.

In terms of integrating the contribution of other, non-military actors, the so-called comprehensive approach which strives to do this seems to be consistently outdone by the military trying to take control of it. Tasks for other agencies derived from AI might actually be considered less intrusive. Further, where actions are not supported as part of the comprehensive approach, this could be quickly recognised and adjustments made to compensate.

3.7 Providing Operational Level operations assessment of progress in achieving operational objectives, and contributing to the Military Strategic Objectives and the NATO Endstate

As alluded to above, automated monitoring of key indicators, specifically effects-related indicators, rather than activity-related ones, could give a more accurate and objective assessment of mission progress. The indicators to be monitored could be derived at least partially by automated logic from the effects and actions they are meant to show progress on.

The capacity to conduct this monitoring could be supported by the exploitation of sensors of opportunity in the form of the plethora of internet enabled devices likely to be present in the battlespace.

3.8 Providing operational input for adapting operations to meet changes in strategic and operational conditions

Dealing with complexity, close monitoring of results and conditions is a recommended method of dealing with unexpected non-linear effects from certain inputs. Computational support to this monitoring gives the potential to iteratively adjust a plan based on observation, rather than the default tendency to adhere to a preordained linear plan.

As the campaign continues, probabilistic decision-making might be able to accurately project the likelihood of success from a given set of conditions and recommend timely remedial action. This could take the form of a stark choice between escalation and the modification of political goals. Something which no politician wants to hear from a military commander might be easier to digest if laid bare in these terms. Considering recent campaigns, it is difficult to imagine how the 'conditions set' for this decision making might be learnt given the subjective and contested concept of victory. However, in conventional warfare the understanding of success is less ambiguous and the ability to project it from a range of conditions sets is a more feasibly useful capability.

3.9 Planning for transition and termination of objectives

The termination of a campaign is usually the subject of its own operations planning cycle, a requirement that might be negated by the continuous planning approach made possible through increased automation. Considering the likelihood of success at any given point during an operation, autonomous decision support tools could recommend optimal termination points that may have otherwise escaped notice.

4.0 PROBLEMS AND POTENTIAL

The above analysis goes to show that in terms of possibility, there is scope for autonomous conduct of large parts of the operations planning process. The next part of this project expands on some of the potential and problems associated with this.

4.1 Meeting complexity with complexity

The basis for the problem-solving approach provided by the operations planning process is to frame a complex problem as a complicated one. The operations planning process acknowledges complexity without effectively addressing it. In theory, human intuition layers on top of the mechanistic steps of the planning process and meets the remaining problem complexity with an appropriate response. By removing the most mechanistic stages of the planning process and trusting them to computers, human brains and their precious intuition are freed to be directed to the complex aspects of the problem.

This potential benefit notwithstanding, it is important not to neglect the contribution that machines might make to addressing complexity themselves. By design, operations are expected to proceed in a linear manner towards a defined and purportedly achievable end-state. Commander's intuition is easily brought to bear at the tactical level, but in large headquarters, adaption to unexpected or non-linear outputs is difficult. A human-machine combination more effectively addresses high volume data than human only models. By virtue of pure computational power, more alternative options can be explored in greater depth. A corollary of both these factors is that partially autonomous systems are in a better position to detect and react to an unexpected output. Thus, such systems could be employed to make planning a genuinely continuous, rather than discreet, activity. Changes to plans might be computationally derived, incorporating iterative changes in a comparatively seamless manner. Greater human-machine integration in the operations planning process might allow us to get closer to a complex approach to a complex problem.

4.2 Evidence-based decision making

Automation of military decision-making processes can make the evidence base behind decisions more readily available. A transparent and understandable process between the derivation of results and the collected data they are rooted in is an essential prerequisite of this. Improved accessibility of the evidence behind decisions is useful, both for improved mission hand-off between the human elements of planning teams, and also to justify decisions made especially in the context of increased legal scrutiny on the conduct of war.

Employment of AI might also be an effective counter to human cognitive biases. Clearly, any deep-learning AI that starts with 'correct' solutions as identified by humans, would replicate and perhaps amplify these very biases. Thus, it would be important at the design stages to make sure that such biases are not transferred into the stages of the operations planning process that seem to lend themselves to this type of programming. Considering the derivation of operational effects from decisive conditions, for example, these would be better derived from accurate and reliable systemic models of the actors involved, rather than from correct answer sets borrowed from previous operations planning exercises.

Automated decision-support and analysis might make it easier to maintain honesty at the strategic-political level. As operations start, and military response options are discussed, a digital evidence base might provide a counter-point to the military's reputed tenancy to overstretch itself on the basis of an unduly optimistic understanding of its own abilities. As a campaign progresses, bad results, when they arise, are at least less likely to be a surprise. The ability to be objective might actually make machines more effective in generating a comprehensive approach, as they could be better trusted by civilian agencies than their human military counterparts. It is important to note, however, that defence-developed AI might be subject to the same level of distrust and that any improvements in co-operation will be contingent on the ability to prove that the AI being used is free from bias.

4.3 Computing Power and Vulnerability to Interference

The potential application of AI to operations planning is partially limited by technical immaturity. Many of the applications of AI explicated above are dependent on the use of models of the operating environment to predict results. Currently, the quality of these models is a significant limiting factor in the utility of AI in the operations planning process. It is important to note, however, that to be useful, these models must not necessarily better human perception itself. Rather the standard they need to improve upon is the significantly lower benchmark of how this perception is transferred between humans involved in different stages of planning. The development of sophisticated models for complex systems in the fields of biological and medical modelling is an encouraging display of potential, as is the application of the same mathematical principles to socio-economic and other social science modelling.[xxxiv]

Despite this, a linked limitation arises based on the scale of the associated hardware. Complex simulation with large amounts of data currently demands processing power which comes with a significant bill in terms of scale and energy usage.[xxxv] A computer capable of sophisticated data analysis and decision-making is unlikely to be agile or deployable in the near future: even if technological developments permit this, a slow-moving defence procurement processes might necessitate a long uptake time. The interim solution might see a move towards centralised staff processes, which take place outside operational theatres. On the positive side, this might result in a reduction in physical exposure, based on the fact that headquarters could be smaller. Despite this, it runs counter to the principles of decentralising decision-making to improve adaptability in the face of unexpected threats or opportunities. The more complicated an understanding of an operational environment is held, the more difficult it is to transmit this understanding down to all levels of command. Developments in distributed computing, storage and communication may redress this to some extent. The need to strike a balance between having resilient and agile infrastructure in operational theatres and placing unrealistic demands on computing power and bandwidth to move data and decisions between deployed and static elements will be an enduring compromise.

Also, any reduction in physical exposure would be traded off with an increase in exposure in the cyber domain. To make full use of autonomous capabilities, relatively unimpeded access to open source data is a requirement. If cyber is to be taken seriously as a domain, the idea that we can continue to protect critical capabilities by not networking them externally may turn out to be a fallacy. To operate in cyberspace, our cyber capabilities must be to some extent exposed, the same way that it is not possible to operate effectively in the land environment without exposing troops or equivalent assets to physical risk. The vulnerability to hacking of any automated weapons system is a huge risk to be protected against. Such activity may not be perpetrated by a declared adversary, but by opportunist criminals or even a sophisticated AI hijacking already available levers of influence.

4.4 Cultural Reticence and lack of Strategic Imperative

Despite the significant hurdles to progress described above, Cummings identified one of the main barriers to military AI development as cultural ones.[xxxvi] Recent campaigns against low-technology adversaries have allowed operational headquarters a relatively slow decision-action cycle. A gradually escalating confrontation with Russia does nothing at this stage to demand faster or better high-level decision-making. Whilst armed forces address opponents whose objectives are stalemate, rather than decisive victory, they will not come up against a genuine need to optimise the decision-making of operational or strategic headquarters. As such, the aforementioned imperative needed to drive change is absent. Notwithstanding this, the USA continues to invest significant resources in AI development, and NATO itself has recently committed to research on autonomy. Because of the preponderance of the United States in terms of spending power it is quite possible that the West might retain the strategic advantage with regards to AI, even though AI research it is not the 'main effort.'

5.0 RISKS AND IMPLICATIONS

After exploitation of current or foreseeable future technologies to make military decision making more autonomous, one of two things could happen. Either AI might evolve further or a point of diminishing returns is reached. The former of these possesses the most far reaching implications and is investigated further below.

5.1 The human bottleneck – machine runaway

The operations planning process as it stands is hallmarked by a consistent requirement for some degree of human supervision. For example, the decision to move between phases is made by the North Atlantic

Council, and the authorisation of a concept of operations, the outline plan, also requires that level of approval. This is a reflection of political control of military decision-making. The exact role of the Operational Commander in the process is flexible, but he or she directs the plan through the provision of guidance. A lot of planning staff processes could be made entirely autonomous. However, many of the tools mentioned in the early parts of this report would be pursued as add-ons not replacements for human decision-makers. As machines are more involved, higher volumes of data are worked through and decision cycles are compressed, a human brain, or indeed group of brains, could then become a bottleneck in the process. Furthermore, such tools could be more effectively applied in a vastly different process, rather than retaining the stages that suited large headquarters of humans. For the sake of efficiency and optimisation, the process itself will change as the means by which it is conducted changes. It is plausible that in time, humans will not be expected to appreciate all the evidence they are making decisions based on, rather we will continue to put faith in intuitive impression-forming by commanders selecting machine generated options. Whilst at the tactical level, human intuition is likely to be irreplaceable in the short term,[xxxvii] at higher level that same judgement is more detached. It is predominantly determined by digital inputs represented physically, as opposed to physical inputs prevalent at the tactical level. Thus, at higher level human intuition is both limited and corrupted by the evidence on which it relies. Use of an autonomous system to inform a decision may, in effect, shape that decision. Thus, the value of keeping humans in the loop might be irretrievably denigrated as more of the planning process is conducted autonomously.

5.2 Shaping the operational environment

The physical domain, as it is perceived by humans, is a sub-optimal environment for an AI. Within cyberspace, so-called 1st wave systems of AI, that is those which are programmed only with logically reasoned steps, can do impressive things. This is exemplified in the grand cyber challenge organised by DAPRA, where the MAYHEM program was able to use data from cyber-attack detection programs, supposedly a protective measure, to expose vulnerabilities. When we develop AI to work in human environments we are investing great effort to make AIs do things that they are not 'naturally' good at. Facial recognition software has required years of investment in incredibly complicated statistical models to get a computer to do something that a new-born baby teaches itself within weeks. It might conceivably be easier for computers to discern human motivations from the speed at which they type certain words on a keyboard, or perhaps less ambitiously, from physiological data collected from sensors of opportunity, than it is for them to identify their faces. Other things which are challenging and take a long time to develop for humans, such as co-ordination with others, are literally hard-wired into computers. It seems likely that an AI which has effective control over planning an operation, will shape that operation to suit its best capabilities. To do this, it may need to extend digital space as far as possible into the physical. For example, in recent campaigns, information operations staff branches have distributed radios to the population to extend their messaging reach. The ideal campaign setting from an AI might see smart devices replacing these, fulfilling the function of biometric enrolment, movement tracking and possibly more intrusive monitoring. Humans identified in transit without such a device may fulfil one item on a check list that leads to their identification as combatants. Initially, such extensions of digital reach are likely to rely on the full collaboration and support of humans overseeing the process. Nonetheless, the ultimate end state might be a battlefield that suits machines and where it is significantly more difficult for humans to operate. For now, the tactical level remains human, but if the orchestrators of campaigns become machines, it is questionable how long this will endure.

Without limits set, AI might develop in a way that mimics organic development. Rather than a precisely human intelligence, the AI might exhibit a different, yet perhaps equally meaningful, type of intelligence. For example, although devoid of biochemical motivations (beyond those that result from learning based on user provided samples) the AI might be subject to other motivations which are complicated enough to remain inscrutable. As such, it could be as unpredictable, or ‘free-willed,’ as a human. Perhaps more significantly, an AI would not be dependent on the same architecture of social technologies (e.g.: families, nation states, companies), because the purposes of these are routed in co-operation between individuals. A significant proportion of human intelligence is naturally selected to advance the ability of co-operation, but these aspects might be superfluous to an AI. Expecting an AI to move through a phase of Artificial General Intelligence, where its characteristics mimic that of humans may be misguided. The use of AI for military planning could give us a shortcut, where an Artificial Narrow Intelligence could become powerfully dangerous, shaping the environment in which it is working, so that within the domain it creates, it is an effective super-intelligence.

5.3 Overmatch by a strategic adversary

Whilst it would be laudable to set strict limits on the use of AI in military planning on the basis of concerns about the implications of its use, it would be a mistake to do so without considering the possibility of meeting an adversary that has not taken these steps. In a conventional conflict, this might mean optimised troop distributions which are rapidly adjusted and redeployed to meet any action taken. Speed of response would be improved further in environments where these troops themselves are autonomous. This is the principle behind ‘swarm’ attacks, and one which would be utilised in full by a primarily autonomous adversary. Control of the electromagnetic spectrum is likely to be decisive in future conflicts, and this is an area in which, for obvious reasons, an autonomous adversary would be advantaged. Likewise, ‘human in the loop’ constraints on any autonomous targeting system could become a strategic disadvantage in the face of an adversary who had similar technology levels, but had removed this stipulation of human control.

In terms of intelligence gathering, access to data owned by large corporations could be decisive. A state with high degrees of public-private sector co-operation would be advantaged in this regard, as would one which is prepared to steal data or insider knowledge using nefarious methods such as espionage. Targets for placing human agents would be the data security architecture of large technology companies, rather than foreign government or intelligence agencies.

Also worth considering is the use of AI to maximise relative advantage outside periods of declared conflict of even confrontation. This might take the form of sabotage of markets or control of the information space, as is already attempted through the use of chatbot nets to dominate the narrative of on-line debates.

Beyond the commitment to fully exploit autonomy to gain maximum strategic advantage, there is a requirement to be capable and effective in doing so. Again, public-private sector co-operation would make sure that the most cutting-edge developments in AI are immediately deployed to best effect. A fusion of effort, rather than depending on an onerous defence procurement process, might see a lower-spending state reap disproportionate advantages

5.4 The dubious value set of military AI

Despite the risk of strategic overmatch by an adversary that is committed to the use of AI for military, and perhaps political, advantage, Western powers currently have higher levels of sophistication in the AI that helps them do their shopping than they do in military decision making. A group of prominent scientists recently petitioned the UN to halt the development of ‘killer robots.’[xxxviii] They would certainly argue that limiting the sophistication of military AI is a good thing.

By virtue of its employment, and based on the nature of the goals which it will be asked to pursue, something like a de-facto value position will arise in any sophisticated military AI. Collateral damage acceptability calculations, for example, will mean that a relative value is placed on human life. War, some would argue, represents the worst of human culture. In humans, it is modified by a desire for peace, but it is difficult to see how you could reflect this civilisation in an AI which is designed to be as good at war as possible. The AI would have to be programmed with values which to a large extent contend with its goals. Bostrum discusses the practicalities of bestowing an AI with values alongside its goal set.[xxxix] The various options he suggests are all future possibilities, none of which are without problems. Until there is practice and sophistication in doing this, it is arguably irresponsible to proceed with developing an AI with such potentially dubious moral standing. Based on this, it seems that such an international ban to limit the use of AI by the military would be a good thing. However, there are likely to be are practical problems with implementing this. Among them, the possibility of states ignoring the ban, difficulties extending the ban to all relevant areas and the impossibility of guarding against systems which are designed to comply with the ban at first but are then are easily modified to violate it further down the line.

5.5 The implications of AI for human value sets

The era of human rights having an impact on international relations arguably began in the wake of the Second World War, although the idea of human rights significantly predates this. The use of industrial means to slaughter unprecedented numbers of humans during this conflict almost certainly set the conditions for human rights to gain traction in place of other doctrines. Another post-Second World War trend, and one associated with the development of nuclear weapons, is a reduction in the utility of state on state conflict for furthering strategic ends. Between nuclear powers, the potential consequences of escalating a conventional conflict to nuclear level renders the risks of direct conventional conflict unduly high. These norms and limitations on the use of force have become accepted, but they may be more fragile than they appear. The rules of 'playing fair' are in part dependent on a level playing field. As such, we have seen frequent derivation from these norms by asymmetrically weaker enemies. For peers engaging in conflict, these norms theoretically mean that post-conflict combatants can move on easier and live together peacefully afterwards. If victory can be assured, they might be considered superfluous.

To date, the opportunity to limit risk through the use of semi-autonomous systems and the ability to conduct targeting at reach has meant there is a higher temptation to conduct pre-emptive engagements outside a declared theatre of war. As such, the threshold for the strategic use of force is lowered. This is evidenced, for example, in the increased use of drone strikes against terrorists outside declared theatres of war.[xl] In this area, developments in AI could already be understood to have predicated changes to international norms. These changes may have humane intent, however as Roff describes 'Modern militaries want to avoid mass casualties by relying on increased distances and (potentially) autonomous weapons. But the potential results are the same: deleterious effects on civilian populations and instability in the international system.'[xli]

Pre-emptive action based on AI supported analytics, precision targeting and the potential to disrupt adversaries who are dependent on systems vulnerable to cyberattack mean that AI supported conflict or confrontation might have greater potential than conventional use of force to subdue or neutralise an adversary rather than completely destroying them. However, as we conduct more and more of our lives on-line, non-lethal actions such as restrictions of digital space and other interference, which may be even more readily automated, could become more punitive than we understand now. If, for example, significant aspects of family or social life are conducted in immersive virtual realities, or access to healthcare and education are reliant internet connections, disruption of these may be an infringement of human rights. AI has been upheld as having the potential to make conflict less bloody and more humane,[xlii] but even if the former might be true, the latter is certainly questionable.

6.0 RECOMMENDATIONS

Recommendations based on the observations in this report start with the need to readjust assumptions about norms and limitations on conflict based on the way autonomy might change the character of war. This work, which is already underway in various forms,[xliii] will underpin other responses and strategies.

Whilst restraining the development of AI, some activity now which supports the effective employment of safe AI in the future would seem advisable. If, for example, algorithmic risk warning might be useful, current events form the dataset through which it will be improved and practiced. Thus, effort might be devoted now to developing and exploiting this dataset. Some successful models for this are in use by private companies and work might begin by procurement of them. Generally speaking, the use of scenarios, rather than real-time examples for the development of AI is extremely restrictive. If the real world is a complex system, scenarios are either a complicated one, perhaps too easily mastered, or a chaotic one, when events occur without a credible causal chain, however unexpected that chain might be.

Mirroring civilian AI development,[xliv] efforts to ensure transparency and control are very important in military AI. To assist this, and to adapt to warfare in the information age, military operational planners should understand and be able to adjust the software they are working with themselves, meaning that coding should become part of the staff skill set. This fluency should be supported by the use of specialist operational analysts for more complicated functions. Rather than the current piecemeal approach of automated assistance to specific stages, the operations planning process should be completely revised with a view to making use of the best of autonomous capabilities alongside human decision-makers in a way that guarantees retention of effective control. The potential for unexpected adverse effects of automation in operations planning are vastly increased by not taking a holistic approach to designing machine involvement.

Whatever measures are taken to benefit from the potential that autonomy offers, the possibility of overmatch in the cyber domain should be taken into account. As such military forces should retain the ability to plan and fight asymmetrically exploiting low tech. In tandem they might redouble efforts to develop offensive cyber capabilities which can disrupt AI used by other competing military forces.

A recommendation mentioned in both the Cummings[xlv] and De Speigelaire et al[xlvi] reports is the importance of improved co-operation with civilian industry. Transnational companies are likely to be key power-brokers in the future, but the grounds on which they are willing to work with conventional militaries might be limited. Collaboration might be based on commitment to develop safe AI and focus on areas associated with restraining rather than maximising its potential use.

7.0 CONCLUSION

War will continue to be an inherently human activity. The suggestions in De Speigelaire et al[xlvii] that AI could herald the dissolution of the use of force in favour of social and economic levers of political influence may not be realised. Strategies to use or counter the use of autonomous systems should be based on their potential use for violent purposes.

Despite the tendency to romanticise the military decision-making process, vast swathes of it qualify for at least one of the three Ds which lend themselves to automation (dull, dirty or dangerous). This essay acknowledges the huge potential to optimise the military decision-making process through automation, but emphasises the need to advance down this path with a plan in mind.

An artificial narrow intelligence designed for military decision-making has the potential to be powerfully destructive. Further military autonomous systems or partly autonomous processes have the potential to be exploited as lethal levers by an external AI. The more fully autonomous the system, the greater the destructive potential associated with its exploitation. It is possible that the cultural reticence associated with military AI is actually an example of good intuitive judgement. Progress towards automating higher level military decision making should be planned and instigated safely. Concurrently, steps should be taken to prepare for confrontation with adversaries who do not apply the same restrictions.

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