A Fertile Soil for AI?

Defense AI in Sweden

Alastair Finlan

About the Defense AI Observatory

The Defense AI Observatory (DAIO) at the Helmut Schmidt University in Hamburg monitors and analyzes the use of artificial intelligence by armed forces. DAIO comprises three interrelated work streams:

- Culture, concept development, and organizational transformation in the context of military innovation
- Current and future conflict pictures, conflict dynamics, and operational experience, especially related to the use of emerging technologies
- Defense industrial dynamics with a particular focus on the impact of emerging technologies on the nature and character of techno-industrial ecosystems

DAIO is an integral element of GhostPlay, a capability and technology development project for concept-driven and AI-enhanced defense decision-making in support of fast-paced defense operations. GhostPlay is funded by the Center for Digital and Technology Research of the German Bundeswehr (dtec.bw). dtec.bw is funded by the European Union – NextGenerationEU.

A Fertile Soil for AI?

Defense AI in Sweden

Alastair Finlan

DAIO Study 23|14

About the Authors

Professor Alastair Finlan is a Professor of War Studies at the Swedish Defence University, Stockholm. He is author of numerous books and articles on military culture, Special Forces and modern warfare. These include: *The Royal Navy in the Falklands Conflict and the Gulf War: Culture and Strategy* (London: Frank Cass, 2004), *Special Forces, Strategy and the War on Terror: Warfare by Other Means* (London: Routledge, 2008), *Contemporary Military Culture and Strategic Studies: US and UK Armed Forces in the 21st Century* (London: Routledge, 2013) and *Contemporary Military Strategy and the Global War on Terror: US and UK Armed Forces in Afghanistan and Iraq 2001-2012* (New York: Bloomsbury, 2014). He has contributed to numerous defense reviews in the UK and is part of the Executive Board of the Scandinavian Journal of Military Studies.

Design

Almasy Information Design Thinking

Content

1 Executive Summary

Sweden is very well positioned today regarding the development of AI for both civil and military applications. Most of the essential conditions are in place to make this high technology Nordic nation an ideal environment for AI to grow, develop and flourish at a rapid pace. This is in part due to bold and relatively recent strategic initiatives from the government and private foundations to invest in Sweden's AI future.

Nevertheless, the long-term fertility of Sweden's AI soil depends heavily on what is nurtured now and, though conditions are as good as they can be, it still requires active planning and preparatory work to ensure that the optimum benefits of this technology for defense AI purposes can be reaped in the future.

The current stage of AI's development in Sweden also comes at a rare moment in history when the country has decided to massively invest in its armed forces in the light of increasing instability in Europe and the War in Ukraine as well as abandon its longstanding policy on neutrality by applying to join the North Atlantic Treaty Organization (NATO) in 2022.

Together, these elements combine to create an extraordinarily beneficial climate for AI to flourish in what is already one of the most advanced and digitally networked societies in Europe.

Research on AI in the defense sector has long roots in Sweden. The country is also home to one of the leading-edge defense industries in the world in the form of Saab that is already incorporating AI into deployable military systems. Much of the initial concept work about AI has already been started and, thanks to the massive investment in AI research in Swedish universities, this should develop rapidly.

The old and now resurrected "total defense" concept in Sweden also promises to ensure the interflow of ideas and technologies from civil society to the armed forces to help defend the country if needed. AI has many significant benefits for the unique strategic circumstances of Sweden with a vast, but sparsely populated territory to defend, which has been identified by earlier research in this area as something that could be offset by these new technologies.

The only major risk for the development and exploitation of AI for defense purposes is the question of prioritization in view of the massive scale required to revitalize and rebuild the Swedish conventional forces. There are so many areas that need attention after over two decades of decline and contraction of resources in the form of units, major equipment and bases.

The question is whether investing in present-day military needs will push back investment in future capabilities (to the detriment of AI research) or whether a balance can be found.

2 Thinking about Defense AI

2.1 A Fertile Soil for AI to Grow?

Sweden has a remarkable track record of success with regard to the production of engineering and technical innovations in the civilian and military spheres that has generated a global impact for a Nordic state with a relatively small population.

The spirit of rigorous scientific enquiry continues to reverberate strongly within and across educational, health, military, political and social realms within Swedish society to the point that Sweden today is one of the most advanced digitalized nation states in the world. From seamless money transfers from mobile phones (*Swish*) to effortlessly networked health systems, from health professional to pharmacy, Sweden offers a rich and fertile environment for the so-called "Fourth Industrial Revolution" (Artificial Intelligence, biotechnologies, and the Internet of Things or IoT) to develop.

The connection between civil society and military organizations is an intimate one and, as Sweden embraces AI into the warp and weft of civil life, it will inevitably feed into and affect the military community that civilians consciously maintain for the security of the state.

Until the end of the Cold War, Sweden regularly recruited around 50,000 conscripts (about 18 years of age) every year and they constituted between 68-77% of the Swedish armed forces at any one time.[1] In time of national emergency, Sweden had an impressive 850,000 military personnel available in the mid-1980s for operations with mobilization.[2]

Historically, the footprint of the armed forces in Swedish society has been surprisingly very large with nearly 10 percent of the nation serving in the armed forces during the latter part of the Cold War. That means that the senior leadership of the workforce in Sweden today will have in all likelihood military experience of some form or another.

Equally, the rapid reduction of the Swedish armed forces at the end of the Cold War shutdown entire units, but conversely opened up space for personnel to move around the services. Consequently, it is not unusual to meet a fighter pilot in the air force who started their military career in the army. This means that there is a degree of porousness in Swedish military culture that is not evident in other countries.

---

1 Sørensen, "Conscription in Scandinavia During the Last Quarter Century," p. 321.
2 Åselius, "Swedish Strategic Culture after 1945," p. 35.

Naturally, the successful adoption of AI will necessarily be infused within a culturally influenced context to characterize a particular Swedish interpretation of this innovative and multi-dimensional technology from a "smaller military" perspective.

Unsurprisingly, Sweden has a long interest in AI given the seamless cosmopolitan connections and networks between scientific communities across continents in the time before the Internet. While the concept of artificial intelligence was first articulated by the American computer scientist John McCarthy in the 1950s, Swedish defense researchers were examining the idea as early as the 1980s.[3]

The critical turning point for Sweden with regard to AI and, as a corollary for its armed forces, occurred a little over five years ago when a scoping study from *Vinnova*, the Swedish innovation agency looked at the state of AI in Sweden. Its conclusions were concerning. It assessed that:

> Swedish AI research has, overall, limited international competitiveness. It is a generally accepted view that development within AI, both in research and commercially, is dominated by the USA, with China being the main contender, while Europe has tended to lose ground, relatively speaking.[4]

This was a surprising statement in view that Sweden possessed considerable advantages over other nations in terms of digitalization and infrastructure. It clearly needed some form of government intervention to set Sweden on a better trajectory for the development of AI in both civil and military areas.

2.2 Sweden Embraces the AI Pathway

Sweden's government in 2018 published its AI strategy called "National Approach to Artificial Intelligence" and set out a bold vision of the future in the first paragraph of the document:

> Sweden aims to be the world leader in harnessing the opportunities offered by digital transformation. By international standards, Sweden is in the vanguard. Many countries have high ambitions for their digital development and Sweden must work hard to advance and strengthen its efforts. If Sweden succeeds, there will be considerable scope to develop Swedish competitiveness and

---

3 Schubert, Artificiell Intelligens för Militärt Beslutsstöd, p. 22.
4 Artificial Intelligence in Swedish Business and Society: Analysis of Development and Potential, p. 14.

welfare. One rapidly evolving field of digital technology is artificial intelligence (AI).[5]

"National Approach to Artificial Intelligence" is primarily focused on stimulating and encouraging growth in AI in Sweden through the development of what it describes as four conditions: "education and training, research, innovation and use, framework and infrastructure."[6] By strengthening engagement in these conditions, Sweden should be well placed in terms of AI in society.

Much of the focus in the document is on growing AI within civil society, but there is a focus within the "research" condition for benefitting from "the synergies between civil research and defence research from a total defence perspective."[7] More specifically, it suggests that:

> AI is also a growing field in defence research. There are potential opportunities for coordination between civil research and defence research, including cybersecurity and autonomous systems, that should be seized.[8]

For a society that is very advanced and highly reliant on digital systems, there is an acute awareness of the vulnerability of all these technologies to malicious attack from outside of Sweden. Equally, though not an area of large development yet by the Swedish armed forces, there is also a recognition that autonomous platforms will be an important technological pathway in the defense sector in the future.

"National Approach to Artificial Intelligence" defines AI quite broadly as "intelligence demonstrated by machines" that is taken from the *Vinnova* report, but it recognizes that there are many definitions of it.[9]

2.3 Total Defense and AI

The Total Defense concept has significant potential to be an indirect driver of the adoption of defense AI as it is designed to meld and harness the power of civil and military spaces in times of national need. Sweden has promoted the concept of total defense for a very long time, and it has become culturally embedded in society and among political and military elites on how to think about war and defense in the modern age.

---

5 National Approach to Artificial Intelligence, p. 4.
6 Ibid, p. 5.
7 Ibid, p. 7.
8 Ibid.
9 Ibid, p. 4.

The Swedish armed forces have famously not fought a war in the name of the state for over 200 years, but its thinking about war and warfare has continued with limited experience of actual combat through international missions with the United Nations and with coalition forces in Afghanistan in the twenty-first century.

According to Sebastian Larsson, the conceptual and historical foundations of total defense emerged in the dark days of the Second World War when Sweden trod a delicate and dangerous diplomatic path between Nazi Germany, the Soviet Union, and the Allies. An official report argued that the lines between civil and military "have to a large extent been erased."[10]

This thinking of an entwinned space between the civilian and military world dedicated together to defend Sweden was further developed throughout the Cold War in which Sweden could assemble and equip a 300,000-man field army,[11] if necessary, by drawing upon its small cadre of military professionals combined with trained conscripts from civil society.

The end of the Cold War witnessed Sweden, along with many nations in Europe, drawdown their military capabilities to exploit the benefits of the peace dividend, but Russia's invasion of Crimea in 2014 provoked a resuscitation of the total defense concept. As James Wither explains, the updated contemporary idea of total defense:

> is defined in Swedish law as "all activities preparing the society for war" and consists of both military and civil defence (Sweden, Government Offices 2018). In contrast to Finland, Sweden abandoned its traditional whole of government and society preparations for defence after the Cold War. Policy changed in 2015, when the government tasked the Ministry of Defence and the Civil Contingencies Agency of the Ministry of Justice jointly to develop a total defence proposal.[12]

In many other societies in Europe, the armed services are often perceived as a separate dimension of society that are given significant autonomy to conduct operations without much involvement of civilians, except in specialist roles. In contrast, Sweden's armed forces have a much larger societal imprint, through residual memory of the original total defense concept in the Cold War and an expectation or norm that the active participation of civil society in defense is critical to military success. This is very different to other countries such as the United Kingdom for instance.

---

10 Larsson, "Swedish total defence and the emergence of societal security," p. 47.
11 Finlan, "The Shape of Warfare to Come," p. 475.
12 Wither, "Back to the Future? Nordic Total Defence Concepts," p. 65.

AI can potentially handle the vast information loads concerning the mobilization of key sectors of civil society such as healthcare to cater for the anticipated needs of the armed forces, if combat occurs. Mobilizing a society, even for a so-called small state like Sweden, with a population of 10 million inhabitants, still requires massive data lakes to be accessed and actioned at appropriate times, using cutting edge mobile phone technology. AI can greatly assist in these critical preparatory measures.

2.4 The Impact of AI on the Future of Warfare

Swedish thinking about AI and its potential applications for the armed forces and for Sweden's security is very much at an early stage. This is reflected in the sparsity of debates about the potential ethical aspects of defense AI, though initial work is beginning to emerge in Sweden.[13]

Consequently, inceptive thinking has been naturally quite conceptual in scope and initial studies suggest that it may have broad benefits across the spectrum of warfare and for the concept of total defense. An early investigation by the Swedish Defense Research Agency or FOI in 2019 made the case that AI could offer "advantages"[14] in specific areas. It argued:

> In today's armed conflicts, conventional military warfare often includes elements of hybrid warfare, such as cyberattacks or propaganda campaigns on social media. Thus, analysis of large volumes of data from various domains is necessary to maintain situation awareness. Given this fact, considerable advantages can be derived from the use of AI. Due to the ability to quickly classify and identify patterns in large data volumes, AI technology is well suited for use in sensor data processing and intelligence analysis.[15]

FOI's research pointed towards various dimensions of warfare that could be augmented by the incorporation of AI data such as sensor analysis.[16] Monitoring of sensors ostensibly seems to be an innocuous and tangential aspect of warfare when compared to the kinetic dimension such as active fighting, but it has even greater significance in the light of the recent introduction of hypersonic weapons

---

13 See Malmio, "Ethics as an enabler and a constraint."
14 Andersson/Gustavi/Karasalo, Artificial Intelligence – Opportunities and Challenges for Sweden's National Security.
15 Ibid.
16 Ibid.

by Russia. Hypersonic weapons are a game-changer in modern warfare.[17] The reason is simple: speed.

The extraordinary velocity of hypersonic weapons places enormous pressure on humancentric command and control systems to respond in a timely manner. Hypersonic speed exceeds the natural abilities of people to react and, consequently, a military advantage gap exists between those who possess this technology (Russia) and everyone else. Swedish researchers argue that AI offers through sensor analysis an ability to improve decision-making cycles[18] by increasing speed of assessment of the raw data being thrown up by different inputs such as "radar signals and sonar data."[19] To a degree, the pace of technology is also acting as another indirect driver of Defense AI is this respect.

The benefits of integrating AI into the military system architecture would potentially greatly enhance situational awareness and act as a "force multiplier."[20] Situational awareness should be elevated to a principle of war (a guideline for planning/action) in the twenty-first century because of the power of innovative and new technologies such as drones that overlap and influence traditional boundaries in warfare.

Principles of war vary from which country under consideration and range between nine and twelve. Many are derived from twentieth century warfare. That said, warfare as witnessed in Ukraine at the moment has clearly undergone some significant alterations in terms of the absorption of new technologies such as drones of all varieties with traditional arms in the form of artillery and infantry.

Together, they have greatly augmented the power of traditional formations that has necessitated the return of old tactics such as the construction of trenches to offset the improved firepower element and exploit the protective qualities of earth and wood. A future refresh of the principles of war in the light of modern technology and praxis needs to embrace the significance of situation awareness with an eye on future AI applications in this area.

---

17 One study suggests that "the most worrying development of hypersonic technologies is best captured by the Russian Zircon anti-ship missile that was successfully tested again in October 2020. According to Russian sources, it propelled a hypersonic projective to a speed in excess of "Mach 8 or 6138 mph" when fired from the frigate, Admiral Gorshkov, and hit a target "298 miles" from the ship in just "4.5" minutes. To put this achievement in context, the deadly French Exocet missiles of the Falklands Conflict are subsonic weapons and fly at speeds of typical contemporary anti-ship missiles around Mach 0.9 or approximately 700 mph." See: Finlan, "The Shape of Warfare to Come," p. 481.
18 Andersson/Gustavi/Karasalo, Artificial Intelligence – Opportunities and Challenges for Sweden's National Security.
19 Ibid.
20 Finlan, "The Shape of Warfare to Come," p. 477.

Another aspect highlighted by the Swedish researchers was the utility of AI when combined with intelligence work. The problem with intelligence in the twenty-first century is the excessive volume of data that often overwhelms the ability of human analysts to see the bigger picture or draw a line between significant dots that point to another "9/11" or "Pearl Harbor."[21] FOI argues that "AI offers an opportunity to identify the unexpected – the so called 'black swan' – by analysing large volumes of traditional intelligence data in combination with open web data."[22] The use of web-based data also facilitated the employment of so-called algorithmic warfare that enables the monitoring of internet traffic and chatter to specifically identity targets of opportunity that can be actioned against by military forces. This was recently demonstrated in Ukraine when a concentration of Russian soldiers being moved up to the front line was precisely targeted with a missile based on this method of identifying clusters of soldiers from their internet/digital footprint.[23]

---

21 Andersson/Gustavi/Karasalo, Artificial Intelligence – Opportunities and Challenges for Sweden's National Security.
22 Ibid.
23 Candlin, "Role of Algorithmic Warfare is a 'game-changer' on the Battlefield."

3 Developing Defense AI

Sweden finds itself in an unexpected place in terms of its defense posture. For years after the end of the Cold War, successive governments in Sweden assumed that defense was a low priority to the point that they drew down their forces and capabilities on a massive scale, from shutting bases, closing down entire military units and selling off heavy equipment such as artillery. The future Sweden imagined was of a small, largely professional military that would contribute to expeditionary international missions without much concern for homeland defense in view of the peaceful and stable European environment.

Russia's seizure of Crimea in 2014 provoked a shift in government and public attitudes towards the issue of defense that has gained significant momentum today. The Russian invasion of Ukraine in 2022 and the ongoing war has solidified defense policy around national defense and the Swedish armed forces find themselves in the challenging position of receiving vast amounts of increased funding while trying to resurrect, reconstruct and revive former capabilities while at the same time looking ahead to the future to see what it should invest in now.

This context dominates the future R&D priorities. An inkling of future direction is provided by a very new publication by the Swedish armed forces called "A Stronger Defense for a Challenging Future" in which it states that "the future operating environment will be greatly affected by technological developments."[24] A great emphasis is place on "digitalization" and the connections between different systems that will facilitate better situational awareness. The research is acutely conscious of the links between the five domains of air, land, sea, cyber and space in future warfare and technologies must have an ability to synchronize within this multidomain environment.[25]

What is interesting between the FOI and Swedish armed forces studies is how the research agency sees many applications for AI whereas the military focus really on just a few explicit pathways for development, but implicitly in the digitalization and the connections between different systems is an ideal developmental area for artificial intelligence.

It needs to be recognized that FOI is a research *support* agency for the armed forces. It can make suggestions and drive research in specific areas, but these are directed by the Swedish military.

The report specifically mentions AI with regard to its future applications with autonomous platforms[26] and intelligence support. This is highly interesting in view

---

24 Ett Starkare Försvar för en Utmanande Framtid, p. 26.
25 Ibid, p. 29.
26 Ibid, p. 27.

that this is an area of limited development within the armed forces, but clearly it sees applications here. Presently, the armed forces have just 8 very small UAVs[27] and has a research stake in Dassault's "nEUROn" drone[28] and has recently become involved "on the margins" with the British Tempest sixth generation fighter aircraft development that may well be unmanned or offering an unmanned option. The focus is clearly on more kinetic options for the future, rather than the more attainable information management dimension of warfare.

3.1 The Swedish AI Ecosystem

There is a fair degree of uneven development in the Swedish AI ecosystem that has been formally recognized by state research agencies and the government. Typically, for Sweden, the solution is a mixture of state intervention and private financing to improve key competencies in the ecosystem linking primarily civilian applications, though increasingly through the total defense posture, it will flow into the military world.

Civil Initiatives

The largest private investment in autonomous systems research was offered by the Knut and Alice Wallenberg Foundation in 2015[29] that is part of the extraordinary family of industrialists and bankers in Sweden who own many famous companies, including *Saab*. Its chairman is Marcus Wallenberg who is also vice chair of the Knut and Alice Wallenberg Foundation.

It is called WASP (Wallenberg AI, Autonomous Systems and Software Program) and involves five partner universities including "Chalmers University of Technology, Linköping University, Lund University, KTH Royal Institute of Technology and Umeå University."[30] It is claimed to be "the largest individual research program in Sweden."[31] This perhaps indicates how important the development of AI and autonomous systems and associated software is to Sweden.

Linköping University is home to the National Supercomputing Centre and has greatly benefitted from WASP's funding. In 2021, it inaugurated one of Europe's fastest supercomputers for AI called *Berzelius*. This has pushed Sweden to the

---

27 Finlan, "The Shape of Warfare to Come," p. 475.
28 Ibid, p. 480.
29 For more on the program, see: https://wasp-sweden.org/about-us/ (last accessed 15 May 2023).
30 Ibid.
31 Ibid.

forefront of these technologies in Europe. *Berzelius* has "94 AI systems, which together consist of 752 GPUs. With more interconnected systems, which also have higher clock rates, the new computing power equates to as much as 470 petaflops for AI calculations."[32] The important aspect to note about *Berzelius* is that it is seen as a "national resource"[33] for all researchers across Sweden so this technology is not parochial to Linköping University and can act as a core engine for innovation and development in the Swedish AI ecosystem.

Military Initiatives

The Swedish armed forces own university, the Swedish Defense University, has also developed over the years expertise in AI systems through encouraging doctoral research in this area that spans technical and warfare dimensions. The massive research funding that the armed forces use to encourage research in areas of national defense interest through programs such as Forskning och Teknikutveckling (Research and Technology Development or FoT) also stimulates critical research across numerous universities and research institutes in Sweden. For 2023 alone, the FoT budget is planned to be almost SEK952 million (nearly USD100 million) rising to over a billion Swedish kronor by 2025.[34]

Along with all aspects of defense, FoT and (Forskning och Utveckling/Research and Development or FoU) funding pathways are enjoying a significant uplift to fulfill the burgeoning research needs of the armed forces as it orientates itself towards potential future warfare.

The Swedish Air Force is the only service that pointedly mentions AI in its list of future capabilities. Admittedly, not at the top of the list, but nevertheless included in its line-up of new strengths.

The Air Force wants to create "a unit for intelligence analysis with support from AI,"[35] It does not go into specific details of what this unit will do, but it can be speculated that such a unit could naturally be employed to develop an overview of enemy forces, movements, strengths, and weaknesses in order to support the Swedish Air Forces decision-making processes at the strategy and tactics levels.

It is quite natural for AI to have just a minor support role at this early stage of development, but with time and confidence built into the humancentric system

---

32 "Swedish AI Research Gets More Muscle."
33 Ibid.
34 Budgetpropositionen 2023, p. 56.
35 Ett Starkare Försvar för en Utmanande Framtid, p. 61.

using this very new capability will undoubtedly encourage further applications if it works well.

It is highly likely that military AI research will be an important aspect of the Swedish AI ecosystem as the shift to greater digitalization and integration of systems will demand much more computer (supercomputer) power in the armed services. This is very much at a nascent stage as other more pressing priorities such as manpower, units, bases, and major equipment programs take precedence, but – inevitably – the armed forces will have to makes some big decisions regarding AI and the supporting AI infrastructure soon, if it wants to fulfil its digital and multidomain ambitions.

3.2 AI Partners in Sweden and Abroad

The Swedish AI ecosystem is fortunate to possess some of the most high technology and globally renown defense industries in the world. *Saab*, for example, is universally known for the quality of its military products and their reliability in modern combat. Most recently, one of its lesser known technologies, the *NLAW* (Next Generation Light Anti-Tank Weapon) has proven to be one of the most effective weapon systems of the ongoing Russo-Ukraine War. It is unsurprising given the history of the company that they are very much at the leading edge of AI for military purposes with a very practical view on what is possible at this evolutionary stage of AI. Two main areas stand out at the moment. These are:

- **Predictive Maintenance**
  Modern military vehicles such as aircraft and ships generate a great deal of data and AI can predict when a problem is likely to arise "before it breaks down"[36] and this potentially saves an enormous amount of cost, but also makes military technologies "smarter"[37] and more effective. Maintenance of vehicles seems an unglamorous part of warfare but some areas of fighting are wholly dependent on them. For example, armored warfare involving modern main battle tanks that has gained great prominence in Ukraine. For every one tank in the field, two will be in the process of being repaired or completely broken down. This is a standard condition of mechanized warfare that has been the case since tanks arrived on the battlefield in World War I.

  AI potentially can affect this dynamic through predictive maintenance and enable military commanders to maximize the utility of their armored forces and air forces in a way not seen in warfare to date. For smaller armies with less

---

36 "AI at Saab: Artificial Eye."
37 Ibid.

resources, it enables them to punch above their weight when fighting against more powerful opposition because they are getting the best possible performance out of their equipment.

- **Massive Data Fusion**

  This is a relatively simple idea that has extraordinary potential across civil and military applications. In essence, according to Saab, it is "a cloud-based data lake where we take data and put it into the context of time and space."[38] This is a very powerful tool because it offers in theory a means to "real-time predictions about the physical behaviours of where people, ships or planes are going, and also predict the contextual behaviours of what these people, ships or planes are actually doing."[39]

  A cloud-based data lake offers many advantages for military services. First, it builds in redundancy into the system because it is not dependent on just one physical platform site. If a key base, facility, or platform is destroyed as a result of combat or hostile electromagnetic fire, the system continues and survives. Second, it lays the connective groundwork for the next step in modern warfare, beyond combined and joint operations towards integrated operations. In theory, the integration of all these sensors through a common data lake offers a powerful machine-based sensitivity to unfolding actions on the battlefield that greatly outstrips people-based capabilities.

  A pressing problem for all military commanders in the modern age is too much data flowing around the system. This is data generated by your own forces, but also hostile data from the enemy that can either swamp the system or be designed to "poison" the data lake. If the AI succeeds, then armed forces with massive data fusion versus armed forces without it have a significant advantage at the strategy and tactics levels because they can "predict" the movements of the enemy and plan accordingly. The commercial applications are also vast, from air traffic control to domestic vehicle traffic management and stock market trading to name just three. Massive data fusion has potentially societal implications and may well affect the relationships between government and citizens from cradle to grave.

  Sweden has longstanding relationships and engagements with many of the leading IT companies in the world such as IBM who are at the forefront of AI research. That said, however, its recent application to join the North Atlantic Alliance or NATO in 2022 promises even greater benefits in terms of AI cooperation for military purposes.

---

38 Ibid.
39 Ibid.

3.3 NATO

The decision by the Swedish government in cooperation with the Finnish government to jointly apply for NATO membership in 2022 is historic in every sense of the word. Abandoning two hundred years of neutrality was no easy step for a country that has tried to stay away from entangling agreements that could potentially drag the country into a major war.

From an AI perspective, the relationship with NATO offers huge benefits and it is likely to be an indirect driver for Defense AI in Sweden. Despite not being a member of NATO yet, the Swedish armed forces have closely followed doctrinal and planning developments in the North Atlantic Alliance. For example, it has been teaching NATO's planning tool or the Comprehensive Operations Planning Directive (COPD) to senior officers undertaking higher education courses for many years. Consequently, what NATO decides with AI will be mirrored to some extent in Sweden and it merits attention.

In 2021, NATO adopted an AI strategy and has moved quickly forward into exploring the potential uses and pitfalls of this technology for its operations. NATO's approach to AI is set out in very clear terms:

> The aim of NATO's AI Strategy is to accelerate AI adoption by enhancing key AI enablers and adapting policy, including by adopting Principles of Responsible Use for AI and by safeguarding against threats from malicious use of AI by state and non-state actors.
>
> By acting collectively through NATO, Allied governments also ensure a continued focus on interoperability and the development of common standards. Overall, with innovation ecosystems implicating different actors and faster technology lifecycles than typically included in traditional capability development systems, the NATO AI Strategy is also a recognition that exploitation of AI will require new efforts to foster and leverage the Alliance's innovation potential, including through new partnerships and mechanisms.[40]

NATO recognizes the military significance of AI and is striving to adopt it in a responsible way that both incorporates its advantages for NATO operations, but also protects it from counter-AI use from potential enemies. In a very typical way for a long-established organization, NATO has put in place certain drivers to push forward with AI research. The first of these is DIANA (Defense Innovation Accelerator for the North Atlantic) "to bring nations and their industries into closer partner-

---

40 Stanley-Lockman/Christie, "An Artificial Intelligence Strategy for NATO."

ship to fund, develop, and field dual-use EDTs, with AI being one of the primary technologies."[41] EDT means emerging and disruptive technologies and DIANA is designed to act as a catalyst for cutting edge research to develop in partnership with NATO.

Alongside of DIANA, NATO has also established the NATO Innovation Fund (NIF)[42] that offers a funding pathway for promising research in this area. These drivers indicate how seriously the North Atlantic Alliance takes AI and how it aims to be at the leading edge of this research in terms of practical applications.

Sweden's membership of NATO (if successful) would thus not only have benefits for the Alliance with regard to AI research, but also open up new avenues for research cooperation and funding in this area.

---

41 Fata, "NATO's Evolving Role in Developing AI Policy."
42 Ibid.

4 Organizing Defense AI

In Sweden, the lead organization with regard to the use of AI for defense purposes is FOI. It has by far produced the most reports and conducted research in this area for quite a long time. FOI has a very central remit when compared to defense research in other countries that are often just part of a wide constellation of competing research agencies vying for government funding. In many ways, the centrality of FOI fits the innate drive for and respect of science-based knowledge and the Swedish armed forces are steeped in it. According to FOI, its purpose is:

> to support the shaping, build-up and utilisation of Sweden's defence resources through its research-based knowledge and experience. In concert with the Swedish Armed Forces and the Swedish Defence Materiel Administration, FOI's task is to develop its knowledge and expertise for the benefit of Sweden's operational defence forces, both in the short and in the longer term, as well as helping to apply this knowledge in the full range of defence processes from perspective studies to evaluation.[43]

FOI researchers are usually civilians that are commissioned by the armed forces and other state agencies to do work/tasks in specified areas.

Essentially, what starts off as innocuous research in FOI can well lead to profound impact in terms of affecting how a technology or concept is adopted and employed at the operational level by the Swedish armed forces. Consequently, what FOI is looking at the paper level with regard to AI has great significance several years down the line given this intimate relationship between researcher and warrior. The relatively small size of the Swedish armed forces and their joint outlook that starts right from initial officer training[44] ensures that ideas percolate relatively quickly in the total organization.

The Swedish Armed Forces can be broken down into:

- The Army (6850 soldiers) with 120 Leopard 2 tanks, 411 infantry fighting vehicles, 1064 armoured personnel carriers, 35 Archer 155mm guns and 6 Patriot PAC-3 systems.
- The Navy (1250 sailors and 1100 amphibious forces) with 5 conventionally powered submarines, 5 Visby Class corvettes, 4 coastal combatants, 133 small combat boats (troop transport), 7 mine warfare vessels and 11 landing craft.
- The Air Force (2700 in total) with 98 Gripen multi-role combat aircraft, 3 Airborne early warning and control aircraft, 8 transport aircraft, 8 RQ-7 Shadow UAV and 53 helicopters.
- Special Forces (2950 with supporting staff)
- In total, 14,600 with 10,000 reservists.[45]

---

43 https://www.foi.se/en/foi/about-foi/swedish-defence.html (last accessed 15 May 2023).
44 Finlan/Danielsson/Lundqvist, "Critically Engaging the Concept of Joint Operations." p. 357.
45 Hackett (ed.), The Military Balance 2023, pp. 137-139.

Providing a detailed breakdown of the Swedish armed forces in this way shows how AI can augment and bind the different aspects of the services to maximize the potential utility of them. It also reveals the challenges that the armed forces face in expanding quickly the size of the individual services in view of how much they contracted from the time of the Cold War. The reintroduction of voluntary conscription is one pathway to increasing the size of the forces alongside of building up the size of the total officer corps. Again, with both measures, it will take years to substantially boost numbers of combat personnel. Nonetheless, the small size and porousness of the Swedish armed forces provide an environment conducive to advancing defense AI as parochial, service-specific interests that can hamper the diffusion of defense AI are less pronounced in Sweden than in other countries.

There has been much speculation in various research papers from FOI as to how AI can best serve the armed forces given the state of its development. Much of the work from FOI focuses on the benefits of AI in terms of C2 (Command and Control) applications using AI for planning, analysis, and execution,[46] but other work stresses the benefits for training purposes.

The most recent defense perspective study, "A Stronger Defense for a Challenging Future" stresses a future in which multi-domain operations and coordination between these domains will be vital. This points naturally towards AI, but it is not explicitly stated as such.

A large part of the problem about AI is that it is quite an opaque technology for people who do not have more than a layman's understanding of it. Explainable AI is one pathway to improve general knowledge and applications, and this is an area that FOI is exploring. Nevertheless, military organizations are inherently conservative and that perhaps has some explanatory value as to why only the Swedish Air Force has explicitly embraced AI so far. Air forces tend to be on the cutting edge of technology so that explains to a degree why the Swedish Air Force has taken this quite radical step forward with this new and promising technological pathway.

The inherently joint nature of the Swedish armed forces will ensure that should AI work well for the Air Force then these lessons will be quickly absorbed by the other two services and increasingly through training with the technology, it should seem a more natural fit. The Swedish armed forces have invested significantly in game and simulation technology for training purposes and AI will fit very well with these applications.

---

46 Schubert/Brynielsson/Nilsson/Svenmarck, "Artificial Intelligence for Decision Support in Command and Control Systems."

5 Funding Defense AI

5.1 The Armed Forces

The funding landscape for Defense AI is unusually beneficial due to the massive increase in defense funding in general, which includes research into specific future technologies and capabilities, but also from civilian sources as well. In 2022, Sweden announced that its defense funding would reach 2% of GDP by 2026 and that funding alone would enjoy an increase of USD800 million in 2023.[47] In total, the Swedish defense budget will grow from USD7.3 billion in 2022 to USD12 billion by 2028.[48]

Admittedly, while much of the funding will go to major equipment projects and expanding the size of the Swedish armed forces; nevertheless, there are also signs of a willing to fund leading edge technologies such as AI. A great focus of the 2023 increase is towards boosting cyber-defenses through a dedicated cyber defense unit that will protect both military and civilian vital IT assets.[49]

5.2 Wallenberg AI, Autonomous Systems and Software Program (WASP)

From purely the civil sphere of research funding, the Knut and Alice Wallenberg Foundation, through WASP described in chapter 3.1, will provide funding over a 15-year period, from 2015-2031 of SEK4.9 billion Swedish[50] (nearly USD500 million) that will be supplemented by more funding from other partners taking the total to SEK6.2 billion[51] (almost USD600 million).

This is one of the largest specific funding programs for AI in Europe and indicates how seriously Sweden intends to build up core competencies for the benefit of Swedish society as a whole.

Specifically, it has the ambition to produce 600 PhD students and an intention to create 80 research groups. They have already recruited 53 international senior faculty and have 80 companies and organizations involved in WASP.[52]

These budget and program trends in Sweden suggest that within five years (the typical duration of a PhD in Sweden) a significant increase of human capital expertise

---

47 O'Dwyer, "Sweden boosts defence spending, NATO goal in mind."
48 Ibid.
49 Ibid.
50 https://wasp-sweden.org/ (last accessed 15 May 2023).
51 Ibid.
52 Ibid.

will be available for both civil, military, and total defense purposes. This represents a significant R&D investment in this area that has manifold societal benefits.

Thanks already to WASP, Sweden now possesses one of the most advanced super-computers in Europe devoted specifically to AI applications that promises to help push and develop the boundaries of research in numerous related fields that have security benefits for society.

5.3 Vinnova and AI Sweden

Vinnova, Sweden's innovation agency, also directly stimulates and funds research into artificial intelligence through an entity called *AI Sweden* that has resulted from a public/private finance initiative.

AI Sweden is "the national center for applied artificial intelligence"[53] and encourages a wide range of activities related to AI across society in Sweden. According to *AI Sweden*, it manages:

> projects of national interest together with our partners in areas such as information-driven healthcare, decentralized AI, edge learning in space, and language models for the Swedish language. Moreover, we are building talent programs and provide courses and resources for driving organizational change.[54]

The founding partners of *AI Sweden* include many of the largest state and private actors in Swedish society, from the National Tax Office (*Skatteverket*) to *Volvo* and a host of universities and private companies such as *AstraZeneca*.[55] It is an extraordinarily influential groups of partnerships that demonstrates how much AI research is being encouraged within Swedish society by the state authorities in close collaboration with private industry.

Many of these organizations and companies have close relationships with members of the armed forces and through the "total defense" approach, the flow of ideas and technologies from civil sector to defense will be intimate. The Swedish armed forces finance a great deal of applied research in defense-related technologies through the FoT and FoU pathways in many of the world-leading universities in Sweden.

---

53 See: https://www.ai.se/en (last accessed 15 May 2023).
54 Ibid.
55 Ibid.

6 Fielding and Operating Defense AI

The application of Defense AI industries is very much at an early stage of development in Sweden with much work ongoing in the civil sphere with a few dedicated companies developing it specifically for defense purposes. Sweden has a long history of thorough testing of military technologies before releasing them for general use and AI is no exception in this respect. To provide one simple example, the *Bofors* gun that was hugely successful in World War II (1939-1945) and was used again in the Falklands Conflict (1982) had "30,000 hours" "on 'the drawing board'" before it went into service.[56] This thoroughness in proving scientifically the efficacy of a technology from a *Bofors* cannon to *NLAW* or AI runs deep within Swedish society and defense industries.

Necessarily, it means that initiatives with AI will take time to become operational but nevertheless there are green shoots of activity right now in specific companies such as Saab with real world applications. As *Saab* publicly admits:

> In recent years we've seen Artificial Intelligence (AI) become a key element in much of Saab's security and defense product portfolio, be it for the likes of surveillance sensors, smart cockpit technology or autonomous sea rescue systems.[57]

The benefits of AI for military sensor information processing are numerous. It can handle significant quantities of data from different sensors and provide a form of fusion capability to render the results as quickly as possible for decisionmakers in a tactical environment. One of *Saab*'s products, the *Information Fusion System*, "collects data and information from a large variety of sources, such as Communication Intelligence (COMINT), Electronic Intelligence (ELINT), Acoustic Intelligence (ACINT) and Geographic information systems (GIS)."[58]

The AI algorithms "can be integrated and trained" with this data to enhance the already powerful processes within the system that focus on classic AI applications such as "speech-to-text, entity detection, topic detection, speaker identification and language identification."[59] Together, a fusion capability such as on offer here provides a powerful augmentation in capability from existing technologies.

This technological augmentation pathway for improving sensor data was clearly highlighted by FOI's influential study and dovetails with a national priority: to be able to defend Sweden from external attack. Sweden is a vast country twice the size of the United Kingdom for instance, but it has a relatively small population of around 10 million. This means as the FOI report indicates:

---

56 Finlan, "The Shape of Warfare to Come," p. 474.
57 "AI at Saab: Artificial Eye."
58 "Data fusion for common processing and reporting."
59 Ibid.

AI could have a significant impact on what has long been one of the major challenges facing the Swedish Armed Forces; namely surveillance of a vast and, in parts, very sparsely populated territory.[60]

This perhaps explains why the first concrete planned use of AI for the Air Force is to provide "intelligence support" and the ability to handle sensor data in vast quantities offers significant benefits for the monitoring of the very large Swedish battlespace.

The complexity of AI necessitates a very large support infrastructure that relies heavily on industry-supplied expertise. Back in 2018, the *Vinnova* report into AI recognized that Sweden lacked sufficient human resources with regard to AI. Its SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis highlighted:

- AI competence hard to recruit
- Lack of competence for digital business models
- Universities and university colleges have weak drivers for flexible professional training
- Many SME have limited resources and competence[61]

The report specifically looked at civil society, but the situation in the military sphere naturally reflects the state of the nation that supplies and sustains its force structure. It is likely, given the huge investment in AI education and training, that the AI competence gap is being gradually filled, but the armed forces will have to rely heavily on defense industries such as Saab to lead the way in developing and sustaining these innovative technologies.

This places a great emphasis on nationally based digital hubs/networks to provide support conduits for the vital AI sustenance that the armed forces require on operations. Inevitably, it reduces the space between civil and military spheres, but within total defense concept, this state of affairs would be seen as a desirable working framework rather than something unusual.

The advanced state of digitalization and networking in Sweden offers enormous benefits regards the successful operationalization of AI capabilities within the national military battlespace, but equally it highlights how important the protection and security of these technologies in the form of wireless communications masts are for Sweden's future defense.

---

60 Andersson/Gustavi/Karasalo, Artificial Intelligence – Opportunities and Challenges for Sweden's National Security.
61 Artificial Intelligence in Swedish Business and Society: Analysis of Development and Potential, p. 13.

7 Training for Defense AI

The potential applications of artificial intelligence for military purpose in the defense realm are manifold and potentially game-changing with regard to autonomous platforms in the form of aerial, land and sea-based armed and unarmed drones.

Nevertheless, this remarkable technology is not immediately human compatible in relation to warfighting utility because it requires training and understanding to grasp how AI sees and interprets the digital and physical worlds.

This element was identified in a 2019 FOI report called "Explainable Artificial Intelligence." It stressed that:

> in the military domain the ability to understand and explain the behaviors of AI systems is critical. In this context, the decisions and recommendations provided by the AI systems may have a deep impact on human lives. This is valid at the tactical level where autonomous weapons and drones are used, as well as at the operational and the strategic level where long-term decisions are made by military leaders and political decision makers.[62]

Put simply, AI is not a "plug and play" technology. Military personnel must be trained alongside of its gradual introduction to understand and develop trust in the AI. For most people, AI is a nebulous term and consequently, researchers have realized the importance of developing "explainable artificial intelligence" so that operators of these systems grasp what the AI can and cannot do.

This is of great significance for any profession in which the risk to life is high, whether it be for military organizations or health agencies of the state.

For the Swedish armed forces, adequate training of key personnel who both operate and command AI systems will be critical to the successful employment of this technology in the field. At this stage, however, this is very much early days, but it is an area that needs to be prioritized in the future in the same way that Sweden's national strategy document places an emphasis on education and training as one of its essential four pillars for AI development.

The likelihood initial use of AI for training purposes will be in the areas of games and simulations that Sweden has considerable experience with, not least at the Swedish Defence University that has a game unit for assisting with officer training.

---

62 Luotsinen/Oskarsson/Svenmarck/Wickenberg Bolin, Explainable Artificial Intelligence: Exploring XAI Techniques in Military Deep Learning Applications, p. 45.

One avenue of exploration is how AI can be used to improve enemy representations and behavior in simulations to make them "more realistic"[63] and have more value to the Swedish armed forces when training. This can be considered one of the easiest aspects of AI to develop that does not require all personnel to understand how the technology works, but rather small teams of experts who create the scenarios and run the technology.

In view that much warfare is platform-based (aircraft, ships, tanks, and armored personnel carriers), it has great potential for leadership training before actually applying these skills physically in the field. It also enables young officers and more senior officers to grasp the bigger picture of the battlespace that is often unseen in actual combat because it is so compartmentalized in terms of geography and place in the order of battle. For example, a soldier of a campaign only sees what is in front of them in terms of platoon-based warfare rather than the bigger picture that senior commanders have. It offers a better or holistic understanding of command networks and functions within a battlespace.

This also throws up an element that is focused upon in explainable artificial intelligence: to show visually (in terms that humans can quickly grasp) how AI reaches its conclusions and translate that facet into a training regime. If the training appears unrealistic, then people naturally enough will not take it seriously and that affects training learning outcomes.

---

63 Kamrani/Cohen/Bissmarck/Hammar, "Beteendemodellering med imitationsinlärning," p. 4.

8 Conclusion

The conditions for the successful development of artificial intelligence for defense purposes are clearly visible today in Sweden, but much depends on how much of a priority it is given. The winds of war from Ukraine are palpably felt in this Nordic country, more so than other European partners such as the UK or Spain, and its historical and cultural links to the region have added great impetus to the revitalization of its defense forces.

Nevertheless, the opportunities afforded by the massive reinvestment in its military forces also carries a risk:

Will investing in the future (capabilities) have a lower prioritization to investing in the present day ones?

The scale of Swedish defense reconstruction is massive, from its army to the navy and the air force, but difficult choices need to be made about new technologies that are already affecting modern warfare such as drones, hypersonic missiles, and AI. It requires not just a technological reinvestment, but an educational one of the same level to grasp the significance of the new warfighting environment unfolding in Ukraine at the moment.

The latter is perhaps harder than the former to achieve because it required new thinking, a shaking up of educational, doctrinal, and training curricula that only the strongest of military leadership and an external shock usually achieve.

Regardless of which, AI is going to develop at a rapid pace in Swedish civil society thanks to a forward-looking national strategy in 2018 backed up by massive amounts of private and public investment. The Swedish government has set the course for Sweden to be at the forefront of the AI revolution within the next two decades and the establishment of one of the most power supercomputers for AI in Europe at Linköping University shows that the country is putting words into practice.

This enlightened approach to AI policy could well lay the foundations for Sweden's high technology society to embrace the benefits of the fourth industrial revolution far sooner than many other countries in Europe.

What links this potential dynamic pathway to AI maturation to its armed forces and the security of Sweden is the total defense concept that will ensure a smooth interflow of ideas and technologies concerning AI between the civil and military spaces.

Through total defense, the Swedish armed forces will be able to benefit from the surge in competency in AI that is already coming to fruition as each cohort of

PhD students is produced. The natural partnership between the cyber realm and autonomous platforms means that demand for AI expertise in the armed forces is likely to grow.

An additional benefit for the Swedish armed forces is the close partnership with one of the globally leading defense companies in the form of Saab that is already pushing forward with the development and deployment of AI at the sensor level but has exciting and cutting-edge applications for it in the near future.

The possession of such a national defense industry with a dynamic research environment will offset any organizational resistance internally from within the armed forces to its adoption.

Externally, the Swedish Defense Research Agency has already laid down much of the initial conceptual work for thinking about AI for defense purposes and it is likely to provide further intellectual support for the armed forces as to the way ahead.

In sum, given the weight of investment in AI by Sweden's government, state research agencies and private foundations, this technology has solid foundations for development in the near term that has great benefits for an armed forces in transition and supported by one of the best defense industries in the world.

The AI future is potentially very bright in Sweden.

Literature

"AI at Saab: Artificial Eye," Saab, 16 September 2021, https://www.saab.com/newsroom/stories/2021/september/artificial-eye (accessed 15 May 2023).

"Data fusion for common processing and reporting," Saab, undated, https://www.saab.com/products/information-and-intelligence-fusion (accessed 15 May 2023).

"Swedish AI Research Gets More Muscle," Linköping University, 24 January 2023, https://liu.se/en/news-item/svensk-ai-forskning-far-mer-muskler (last accessed 15 May 2023).

Andersson, Christer, Tove Gustavi, and Maja Karasalo, Artificial Intelligence – Opportunities and Challenges for Sweden's National Security, Offprint from Strategic Outlook 8, FOI Memo 6869 (Stockholm: FOI, 2019), https://foi.se/en/foi/reports/report-summary.html?reportNo=FOI%20Memo%206869 (last accessed 15 May 2023)

Artificial Intelligence in Swedish Business and Society: Analysis of Development and Potential, Vinnova Report, VR 2018:09 (Stockholm: Vinnova, 2018), https://www.vinnova.se/contentassets/72ddc02d541141258d10d60a752677df/vr-18_12.pdf (last accessed 15 May 2023).

Åselius, Gunnar, "Swedish Strategic Culture after 1945," *Cooperation and Conflict*, 40:1 (March 2005), pp. 25-44.

Budgetpropositionen 2023, Regeringen.se, 8 November 2022, https://www.regeringen.se/rattsliga-dokument/proposition/2022/11/prop.-2022231 (last accessed 15 May 2023).

Candlin, Alex, "Role of Algorithmic Warfare is a 'game-changer' on the Battlefield," Forces Net, 12 January 2023, https://www.forces.net/technology/role-artificial-intelligence-game-changer-battlefield (accessed 15 May 2023).

Ett Starkare Försvar för en Utmanande Framtid. Slutredovisning av Försvarsmaktens Perspektivstudie 2022. FM 2022-19979:15 (Stockholm: Försvarsmakten, 2022).

Fata, Daniel "NATO's Evolving Role in Developing AI Policy," CSIS, https://www.csis.org/analysis/natos-evolving-role-developing-ai-policy, 8 November 2022 (last accessed 15 May 2023).

Finlan, Alastair, "The Shape of Warfare to Come: A Swedish Perspective 2020-2045," Defense and Security Analysis, 37:4 (November 2021), pp. 472-491, https://www.tandfonline.com/doi/full/10.1080/14751798.2021.1995976 (last accessed 15 May 2023)

Finlan, Alastair, Anna Danielsson, and Stefan Lundqvist, "Critically Engaging the Concept of Joint Operations: Origins, Reflexivity and the Case of Sweden," Defence Studies, 21:3 (June 2021), pp. 356-374, https://www.tandfonline.com/doi/full/10.1080/14702436.2021.1932476 (last accessed 15 May 2023).

Hackett, James (ed.), The Military Balance 2023 (London: Routledge, 2023).

Kamrani, Farzad, Mika Cohen, Frederik Bissmarck, and Peter Hammar, Beteendemodellering med imitationsinlärning. FOI-R-4890-SE (Stockholm: FOI, 2019), https://foi.se/en/foi/reports/report-summary.html?reportNo=FOI-R--4890--SE (last accessed 15 May 2023).

Larsson, Sebastian "Swedish total defence and the emergence of societal security," in idem and Mark Rhinard (ed.), Nordic Societal Security: Convergence and Divergence (London: Routledge, 2021), pp. 45-67

Luotsinen, Linus J., Daniel Oskarsson, Peter Svenmarck, and Ulrika Wickenberg Bolin, Explainable Artificial Intelligence: Exploring XAI Techniques in Military Deep Learning Applications. FOI-R-4849-SE (Stockholm: FOI, 2019), https://foi.se/en/foi/reports/report-summary.html?reportNo=FOI-R--4849--SE (last accessed 15 May 2023).

Malmio, Irja, "Ethics as an enabler and a constraint – Narratives on technology development and artificial intelligence in military affairs through the case of project maven," Technology in Society, 72 (February 2023), pp.1-10, https://www.sciencedirect.com/science/article/pii/S0160791X22003347 (last accessed 15 May 2023).

National Approach to Artificial Intelligence (Stockholm: Government Offices of Sweden, 2018), https://wp.oecd.ai/app/uploads/2021/12/Sweden_National_Approach_to_Artificial_Intelligence_2018.pdf (last accessed 15 May 2023).

O'Dwyer, Gerard, "Sweden boosts defense spending, NATO goal in mind," Defense News, 22 November 2022, https://www.defensenews.com/global/europe/2022/11/22/sweden-boosts-defense-spending-nato-goal-in-mind/ (accessed 15 May 2023).

Schubert, Johan, Artificiell Intelligens för Militärt beslutsstöd. FOI-R-4552-SE (Stockholm: FOI, 2017), https://foi.se/en/foi/reports/report-summary.html?reportNo=FOI-R--4552--SE (last accessed 15 May 2023).

Schubert, Johan, Joel Brynielsson, Matthias Nilsson, and Peter Svenmarck, "Artificial Intelligence for Decision Support in Command and Control Systems," Proceedings of the 23rd International International Command and Control Research & Technology Symposium, Pensacola, USA, 6-7 November 2018 (Washington, DC: IC2I, 2018), paper 30, http://internationalc2institute.org/s/23rd_ICCRTS_Revised_paper_30.pdf (last accessed 15 May 2023).

Sørensen, Henning, "Conscription in Scandinavia During the Last Quarter Century: Developments and Arguments," Armed Forces & Society, 26:2 (Winter 2000), pp. 313-334.

Stanley-Lockman, Zoe and Edward Hunter Christie, "An Artificial Intelligence Strategy for NATO," NATO Review, 25 October 2021, https://www.nato.int/docu/review/articles/2021/10/25/an-artificial-intelligence-strategy-for-nato/index.html (accessed 15 Mary 2023).

Wither, James Kenneth, "Back to the Future? Nordic Total Defense Concepts," Defence Studies, 20:1 (2020), pp. 61-81, https://www.tandfonline.com/doi/abs/10.1080/14702436.2020.1718498 (last accessed 15 May 2023).

Defense AI Observatory Studies