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The operational value of EW in Contemporary Warfare – a Scandinavian view

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Abstract. Electronic Warfare capability has proven its value on the battlefields of Ukraine on a scale hitherto never seen. This applies to air, naval and land warfare, as well as to operations in the space, cyber and information domains. Information superiority has proven its worth once again, even on a tactical level using distributed EW. One contributing factor is the rapid technology development cycle which has enabled both sides to use uncrewed or even autonomous vehicles with assorted EW payloads, for example repeaters for increased range for remote sensing and communications as well as jammers. Against this background it is relevant to raise the question how the current rapid development will manifest itself in future warfare and what the limiting and enabling factors will be when aiming to beat the opponent in achieving the best inventive EW solutions. This paper aims to explore a consolidated, open source based view on lessons learned from Ukraine concerning Electromagnetic Spectrum Operations and their implications on tactics and operations in contemporary warfare. From this standpoint, the purpose of this paper is to describe challenges and opportunities in future warfare, based on observations in Ukraine and applied to an Arctic context. The method applied is a survey of the field, with the addition of a military contextual analysis and prognosis. The basis is a thematic overview using open source information sources, primarily originating from the Swedish Armed Forces, The Swedish Defence Research Agency (FOI) and the Swedish Defence Materiel Administration (FMV). Thereby this paper largely rests on information from three independent Swedish defence agencies. From observing the ongoing war in Ukraine this paper concludes that the current operational environment is under rapid and constant change, and the experiences made are vital to understanding the dynamic nature of contemporary and future warfare. The question is which factors will be the game changers, and therefore the most valuable lessons, if applied to combat operations in the Arctic?



Keywords: electronic warfare, electromagnetic spectrum operations, uncrewed systems, contemporary warfare, rapid development, innovation, Arctic warfare.

Introduction

One of the few known aspects of the future battlefield is that the next war will not be like the present war. One factor introduced in the current war is the enhanced and distributed use of EW. Consequently, the debate on the operational value of EW in contemporary and future warfare has been refuelled in force. The debate has covered several aspects regarding how to best utilize EW as compared to conventional hard-kill warfare, for example, the rumour of the demise of the tank and manoeuvre warfare seems to have been severely overrated.

There are many thoughts and ideas regarding EW in future warfare, several of which are just that, thoughts and ideas. There are a multitude of unknowns in this equation as the studies of the future is faceted by uncertainties, guesswork and assumptions.

Nevertheless, studies must be conducted in order to facilitate proper and relevant development. This, in turn, calls for a fair share of investment as these studies lay the foundation for the war fighters and weapons of the future. Preferably, future concepts are thoroughly investigated from different angles, considering overarching operational and tactical perspectives, and thereby forming and defining a viewpoint of a new map for the future battlefield. These early thoughts serve as blueprints for the combat equipment and field manuals 20 years from now.

A good starting point is to assess the state of contemporary warfare and combine these assessments with some forward leaning creative descriptions of possible technological development. Assessments and descriptions can then be compared to a historical review of earlier technological leaps in an attempt to identify gaps.

From the viewpoint of contemporary conventional warfare, with high intensity and an ever increasing combat tempo, a few important questions arise:

How to enhance military operations with EW capabilities without making your actions and counteractions predictable and therefore less prone to have the intended effect?

How to operate and conduct offensive combat operations on a higher tactical level?

What effect will autonomy and autonomous vehicles (land, sea, air, subsurface, space) have upon EW?

This paper aims to address these questions on a conceptual level, with the currently ongoing Russian illegal war in Ukraine as an analytical framework. The work is confined to concepts, historical as well as contemporary. Furthermore, contemporary lessons are considered and used as a foundation to glance at future combat concepts viable within a time span reaching from 10 to 20 years from now.

The aim of this paper is to first present a brief literature overview and, based on the overview, discuss possible concepts for future force development. The contents of this paper is delimited to be based on and consist of aggregated publically releasable information.

Materials and Methods

The method of the present work is similar to a survey of the field, with the addition of a military contextual analysis and prognosis.

The basis is a thematic overview using open source reports, primarily Swedish reports from the past three years. Gap analysis is briefly provided by comparing “classic” (most notably ground warfare tactics) and doctrinal approach to the conceptual framework from the open source reports.

Results

For the past few years, there has been an ongoing discussion in military academia and military R&D regarding the future of armoured warfare when exposed to an increased tempo in development



of Electronic Warfare capabilities (sensors, weapons) as well as in the space and information domains. The tank has proven its value and the rumours of its imminent demise are severely overrated. However, the discussion has addressed the need to rework the basic ground tactics more or less taken for granted for almost a century (if not more).

The Swedish Armed Forces has recently presented its (publically releasable) initial key findings when analysing the ongoing war in Ukraine (Försvarsmakten, 2024). These findings point to the overarching difficulties caused by an ever increasing need for rapidness in the decision cycle as well as in the kill chain. This increased tempo is partially due to the high density of sensor coverage and the connectivity of sensor networks. Seemingly unlimited sensor data presents military thinkers with a theoretical problem of width and depth: How to conduct operations in accordance with classical military ground tactics while facing growing hardships in concealing units and movements, combined with the threat from extended ranges for indirect fire support and ground attack missiles?

One observation is that combat is conducted with two opposing post-Soviet military systems. Ukraine still has a theoretical base in the Soviet system, but is also rapidly developing its military due to western influences and extensive Ukrainian combat experience. This has proved to be quite successful when it comes to the development of tactics and materiel. However, the Swedish Armed Forces does not observe any new operational concepts or principles.

Osflaten (2023) points out several factors in Russian Land Warfare that seem to have remained more or less constant throughout the past 40 years, and not likely to be altered in the coming 10 to 20 years either. One such important notion is the Russian (the Soviet) Ground Forces have envisioned a frontline that has to be breached, a notion dating back to the 1920s and 1930s, a time when western military theorists were trying to get their heads around lessons learned from World War I and how to restore manoeuvre as a centrepiece on the battlefield. The western theorists envisioned manoeuvrability as a key ingredient in the wars to come, or as in the French case, decided to build impregnable fortifications to render all offensive actions worthless in the face of well-fortified units with the ability to control their surroundings with accurate and well-distributed fire missions. This would halt an enemy offensive and keep the enemy occupied until own armoured units could turn up and strike a decisive blow to the enemy. The Russian solution to enable manoeuvre, albeit still envisioning the breaching of a contact line, was concentrated firepower enabling a breach in the contact line, a breach which could then be exploited. Using more coordinated fires followed by swift manoeuvre by infantry units the breach is completed, which in turn could be further exploited by the use of mechanized and/or armoured units (Osflaten, 2023, p.42; Ulfving, 2005, p.69). This bears some resemblance to the battlefield of Ukraine today and the fact that Russia has focused a lot of its military resources into artillery. Russian Warfare is artillery centric¹ by nature and Russia has based much of its operational thinking upon combined arms Warfare as a consolidated approach (Osflaten, 2023, p.73), even since before the Second World War.

Another key aspect brought forth by Försvarsmakten (2024, p.5) is the observation that close to no joint operations have been conducted by the Ukrainian armed forces, and the few executed have been partially or totally abandoned from time to time due to pressing matters in one domain. This, in the view of the Swedish Armed Forces, demonstrates the importance of continuously, if not constantly, presenting the enemy with a dilemma in close to all domains, in order to force the enemy to act upon this dilemma and consequently lose the initiative.

One dilemma presented by the Russians has been their superiority in firepower that, especially in the early stages of the invasion in 2022, limited Ukrainian defence and combat operations. Ukraine on the other hand has presented another dilemma: uncrewed vehicles. These uncrewed vehicles have

¹ As can be discerned in, for example, the description of the battle of Poltava in 1709 where Dr Englund states the difference between the Swedish Army Doctrine of the time that emphasized manoeuvre over fire as opposed to the Russian view where the artillery was the centrepiece of land battle (Englund, 1995, p.86).



been used with increased success in missions and tasks such as: monitoring enemy movements, controlling fire support missions, conducting long range strikes deep into Russian territory, and combat Russian naval combat operations. The latter will most likely have an impact on naval war theory, as the Ukrainian navy has been minimal for the duration of the war but still able to eliminate close to a third of the Russian Black Sea Fleet (Försvarsmakten, 2024, p.5).

The progress in Ukrainian warfare is impressive and stands in contrast to the rigid structures of Russian command and control. The use of EW is comprehensive on both sides and uncrewed vehicles have become a strong contribution on the battlefield. How such systems are deployed will likely influence outcomes also in future warfare.

Discussion

This paper is intended to present a Scandinavian perspective on lessons learned from Ukraine and to connect these observations to some evident gaps in the classical military thinking taught in Western military for close to a century. Furthermore, this work attempts to point out topics and development of interest with regard to effective future combat operations enhanced by EW.

One immediate observation is how much there is to learn from the ongoing war in Ukraine. Amongst its western friends and partners Ukraine is the only country in modern time engaged in a conventional war with a peer or near peer nation. Ukraine achieves a unique edge when it comes to experiences from utilizing military innovation, perseverance in the face of severe challenges, and adaptability of tactics and technology to fit a new kind of warfare.

Considering the rapid development in the enhanced and distributed use of EW, it is interesting to ask how to make the best use of technology while still maintaining the essence of the classic conduction of combat operations and war in general. Is it at all possible or do we need to replace the old thinkers?

The war in Ukraine serves as an example of contemporary modern warfare where most of the world as of now is in deep amaze with regard to the utilisation of EW, uncrewed systems (weapons and sensor systems alike), and yet, simultaneously, somewhat surprised by the resurrection of trench warfare. This new kind of warfare has similarities with what scholars thought would be the case with “the next war” but it is still very different because of the combination between old and new: soldiers in trenches driving the use of cutting edge sensors and rapidly developed remote controlled weapons.

Despite deployment of new technology, operations conducted by both Ukraine and Russia have shown no observable signs of warfare by implementation of novel operational concepts or principles (Försvarsmakten, 2024). The notion that development of such operational principles are inherently difficult to achieve is a motivator for this paper. Drawing conclusions about suitable novel operational concepts based on lessons learned from Ukraine is challenging, as they indicate a shift in tactical approaches, especially with regard to ground warfare.

Dispersed combat actions have proven to be a successful approach to maximise survival on the battlefield. The classical concentration of forces in close proximity to assault targets operations as per pre 2022 is likely to result in the demise of said forces today due to enemy fires already in an early stage of an assault. This comprises an operational and tactical problem for most military planners and thinkers, and should provide a severe problem for the Russian Ground Forces in particular, given their rigid command structures.

The Russian way of war is top heavy when it comes to command and control and the Russian planning process, preferably with maskirovka (with a severe degree of OPSEC), in conjunction with top heavy C2 (Ulfving, 2000, p.97) is what could diplomatically be put as “rigid”. If one were to combine these factors with elements of “fog of war” and a transparent battlefield forcing each side to conduct dispersed combat actions if not to lock horns in a battle of attrition along the contact line, then achieving the necessary tactical dynamics could prove to be difficult for the Russian Armed Forces. At the same time, Lars Ulfving (2005, p.128) explicitly warns about making wrong decisions



and thereby commit hazardous mistakes based on a view of Russian tactical unsophistication.

The Russian art of war is based on the notion that the operational level is where strategic goals are met and therefore flexibility is prioritized on the operational level, not at the tactical level. Flexibility and swiftness on the operational and strategic level requires extreme simplicity on the tactical level according to the Russian point of view (Ibid, p.128, p.149). That said, Russian losses will probably stay at the high levels of today even in the next war, due to unsophisticated tactics and a rigid C2-system, a rigidity that can be exploited by EW and socio-technical measures ensuring a more refined and swift OODA-loop. This is where the Russian Armed Forces are weak, and have been historically as well: their rigid C2-system that minimizes the allowance for initiative on lower levels due to requirements for simplicity on the tactical level to enable flexibility and tempo on the operational and strategic level. EW can provide an edge in order to dazzle and delay enemy actions and reactions thus enabling the own sides combat actions to deliver decisive blows on a tactical level where the enemy is weak C2-wise. If ones operational OODA-loop is swift enough and tactical blows can be dealt, Russian operational flexibility will be unable to remedy the lack of tempo and flexibility on the tactical level. As Mission Tactics are close to being interpreted as a tropical fruit in Russia, this can be exploited.

EW can contribute to enhanced Situational Awareness, adding speed and diligence for OODA-loop(s). As EW can also be used to hamper the enemy's C2 systems and OODA-loops, how the terrain can inflict upon combat operations supported by EW measures becomes an important question. As this paper aims to describe a Scandinavian perspective on the value of EW in Contemporary Warfare, certain considerations needs to be made with regard to the implications of the terrain in, primarily but not exclusively, Land Warfare Operations.

The terrain in Sweden and neighbouring countries such as Norway and Finland are quite different from the landscape in Ukraine. Certain similarities with Ukraine can be found in the Baltic Countries, the countryside is relatively flat with a large degree of farmland, which historically is deemed favourable for armoured warfare, something that the war in Ukraine has started to question due to the impact of EW in combination with a swift and decisive use of direct and indirect fires.

Experiences from military operations in for example the northern parts of Finland date back to the Second World War (Siilasvuo, 1999). The terrain in these parts of Finland can be quite similar to large parts of northernmost Sweden and Norway but also Russian territory at the same latitudes. The landscape consists to a large degree of forests and damp "marshes" and established durable roads are scarce, thus confining advancing troops as well as following logistics to these roads which in turn exposes these formations to risk by e.g. light infantry, ranger and Special Operations units and following indirect fires. This was proven during the Finnish Winter War 1939-1940 and was also built upon in Swedish, Norwegian and Finnish defence planning and preparations during the Cold War. The enhanced utilisation of uncrewed systems and EW capabilities further supports this approach as well as constrains the just mentioned ranger tactics as the degree of survivability most likely will depend on how well these factors are understood and tactically implemented. The ability to maintain the initiative in spite of the new spectrum of threats that is presented by the systems and capabilities manifested in Ukraine as this is written will be instrumental to achieve victory on the battlefield.

The naval and aerial combat will have corresponding challenges. From a navy perspective the former use of the archipelagic terrain as a means of cover and concealment might be questioned to some extent, especially with regards to SPACEINT/IMINT. New emerging threats from USVs and UUVs need to be countered to avoid strikes like the severe blows the Russian Black Sea Fleet has suffered since 2022.

Control of the airspace has been a key factor for almost a century, who controls the sky controls much of the success of military operations. This is true today as well and most likely will be true also in the next war (Försvarsmakten, 2023, p16). EW and uncrewed systems can deliver an edge in this



regard but nevertheless, aerial combat operations will enable military operations as a whole. The aerial combat operations will need to consider events on the ground to a larger extent than before due to the increasing sensor coverage that will limit the ability to deploy in the countryside using roads etcetera. This is still a viable approach but must also take into consideration the increasing threat posed by enemy UAVs and long range fire missions that supported by COMINT, SIGINT and SPACEINT will force ground crews and operational planners to plan for a greater mobility than previously. Signature dependency is therefore something that not only applies to army units but also Air Force ground assets.

As has been shown in Ukraine the traditional sense of warfare with rear areas and a frontline is still viable but there is also an increased “grey area” that covers a larger part of the operational area as the enemy projects a threat by indirect and long-range fires against multiple targets and population centres over time and space. This will probably affect combat operations in the high north as well, possibly with a slightly lesser impact due to the decrease in satellite coverage above certain latitudes. However, satellite coverage increases continuously and it is still unclear how the current deficiency will be addressed and countered in the years to come.

It can be argued that EW as a concept has been widened when it comes to the implication not only for EW units but for all units participating in combat operations regardless of the principal domains. This is also an argument for Multi Domain Operations (MDO) as the tempo in combat operations increase and the domains will be more and more entangled with regard to Command and Control, and the need for further distribution of sensor coverage and sensor data. A further impacting factor is the increase in range and precision for certain types of weapon systems which in turn has an impact on the threat level over a larger portion of the operational area. In the Swedish context, which can be seen as somewhat more geographically constrained, the classical dimensions of Land, Sea and Air Warfare therefore seems to be more interlinked by default, thus implying that MDO might be viewed as an existing relevant option and not only driven by a NATO strategic narrative.

Lastly, it is worth mentioning that Russia puts a great deal of importance not only into its capability to operate with severe indirect fire support but is also deemed to do so with the use of nuclear weapons (Osflaten, 2023, p.63). Russian doctrine is quite explicit with regard to the option of first strike capabilities (Ulfving, 2005, p.69). EW will have a role to play also in this aspect, for example regarding the measures and countermeasures for certain long range weapon systems, and the denial of communication and coordination of nuclear assets en route or even before launch.

Conclusion

The ongoing war in Ukraine clearly shows that some parts of contemporary warfare stays constant in line with the way that wars have been fought for the past several hundred years. Fire and manoeuvre is still what brings victory on the battle field in combination with the ability to gain cover and protection, either by using fire and/or manoeuvre or by increasing ones protective stance by other means. Manoeuvre and armoured warfare will still play a role in ground warfare for several years to come, however the classical approach of concentration and breakthrough will probably need a doctrinal revisit for most countries due to several technological breakthroughs, and this is where EW comes in as a strong factor.

EW provides an armed force with an edge, in many ways because of the close link between the EW and intelligence communities in most countries. Data and knowledge is king and can, to some degree, trump the strengths of classical warfare. EW measures can, and *have* for the past three years in Ukraine, be exploited to achieve an advantage over the opponent’s conventional strike forces.

Recommendations

The authors recommend further studies regarding how to conduct successful, long term, combat operations on a higher tactical and strategic level. These studies will likely prove to be most valuable on the future battlefield and, if correctly conducted, will also have a great impact not only with regard



to manoeuvre and tactics but also with regard to logistics, combat logistics, command and control and other enabling subjects.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Оперативне значення радіоелектронної боротьби в сучасній війні з точки зору скандинавських країн

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Анотація. Спроможності радіоелектронної боротьби (РЕБ) продемонстрували свою ефективність на полях бою в Україні в масштабах, яких раніше не спостерігалось. Це стосується повітряних, морських і наземних операцій, а також дій у космічному, кібернетичному та інформаційному просторах. Інформаційна перевага знову підтвердила свою цінність навіть на тактичному рівні завдяки розподіленим системам РЕБ. Одним із чинників цього є швидкий цикл розвитку технологій, який дозволив обом сторонам використовувати безпілотні, а іноді й автономні платформи з різними засобами РЕБ, наприклад ретранслятори для збільшення дальності розвідки й зв'язку, а також засоби радіопридушення. У цьому контексті постає актуальне питання: як нинішній стрімкий розвиток проявиться в майбутніх воєнних конфліктах і які чинники сприятимуть або обмежуватимуть досягнення переваги над противником у створенні інноваційних рішень у сфері РЕБ? Метою цієї статті є дослідження узагальненого погляду на основі відкритих джерел щодо отриманих уроків з України у сфері операцій в електромагнітному спектрі та їх впливу на тактику й ведення бойових дій у сучасній війні. Відповідно, стаття спрямована на опис викликів і можливостей у майбутніх воєнних конфліктах на основі спостережень в Україні та їхнього застосування в арктичному контексті. У дослідженні застосовано метод загального огляду з додаванням військового контекстного аналізу та прогнозування. Основу становить тематичний аналіз відкритих джерел, насамперед матеріалів Збройних сил Королівства Швеція, Шведського агентства оборонних досліджень (FOI) та Шведського агентства оборонного матеріального забезпечення (FMV). Таким чином, робота значною мірою базується на інформації трьох незалежних оборонних установ Королівства Швеція.

На основі спостережень за тривалою війною в Україні зроблено висновок, що сучасне оперативне середовище змінюється швидко та постійно, а набуті у процесі досвіду знання є ключовими для розуміння динаміки сучасної та майбутньої війни. Виникає питання: які саме чинники стануть вирішальними і які уроки виявляться найціннішими у разі їх застосування до бойових дій в арктичному регіоні?

Ключові слова: радіоелектронна боротьба, операції в електромагнітному спектрі, безпілотні системи, сучасна війна, стрімкий розвиток, інновації, арктичні операції.