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Artificial intelligence is entering every aspect, including the military domain. When you listen to discussions about the future of defence, several older, let's use the word, experienced military experts dominate the debate. This raises questions about whether we are in a completely new world that requires a completely different approach to defending one's country. Does Denmark have the right military leadership to stand firm? Do we have the right organisational structure? Do we have the right arsenal? Last but not least, do we have time to find the answers?

Insightview.eu discusses this with Andreas Graae. Andreas is an expert in military technology. He is 40 years old and an Assistant Professor at the Department of Military Technology at the Defence Academy, where he researches how new and disruptive technologies such as drones, artificial intelligence, and autonomous systems change and shape today's and tomorrow's battlefields and military culture.

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First of all, Andreas Graae, thank you for participating in this podcast.

Andreas Graae, Royal Danish Defence College

You're welcome!

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Denmark faces massive defence investments. Many taxpayers are concerned about whether the Danish military can handle such a process, given the series of procurement scandals in the defence sector. As a layman, I must admit that I am also worried about whether we are investing wisely in a period when technology is changing at breakneck speed. Denmark is one of the most digitalised societies in the world, but the question is whether we also have the right team. Here, I am thinking about the right generational composition in the Danish military that can lead us into a high-tech future.

Andreas Graae, Royal Danish Defence College

Yes, that's a good question. Undoubtedly, many skilled people in the Danish military are making decisions. However, there's a technological reality advancing rapidly, and much of this development is driven by the private sector.

I believe the military is a relatively heavy organisation with a large bureaucracy and a very particular culture. And such things take time to adapt to a reality where technological development is happening very quickly. So, I definitely think there are

challenges in creating the necessary cultural change. Again, in terms of trying to bring in younger people who have their fingers on the pulse and know which technology areas are particularly interesting and offer opportunities but also pose challenges for the military organisation.

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Let's take a practical example. Denmark recently purchased some quite expensive F-35 aircraft and other costly equipment. Given what we've just discussed, are we making the right investments? Could we achieve greater effectiveness if we invested differently, focusing on technologies we haven't yet utilised?

Andreas Graae, Royal Danish Defence College

I think it's a balance. Fighter jets are still a crucial capability for the military. Tanks are also not obsolete, as we've seen play a significant role in the war in Ukraine. But I think it's about becoming more agile, adaptable, and better at exploiting combinations of the classic expensive capabilities like F-35 fighter jets. Then, the rapid development of artificial intelligence, robots, and drones. And I think we're still thinking a bit too traditionally about how we utilise the opportunities that, again, the ever-lowering price of drones, for example, presents.

In the future, it might become too expensive to send some of these F-35 fighter jets into war, which can cost a billion kroner each. Instead, we will likely see examples where cheap drones, costing as little as a few thousand kroner each, are sent in large numbers and swarms. So, I think the combination of high-tech, expensive platforms and the very low-tech, simple, cheap platforms and systems will make a difference.

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But is that the transformation we're currently undergoing?

Andreas Graae, Royal Danish Defence College

The problem is that we lack people and a development in thinking that focuses on innovation in the military. It often becomes a question of how we solve our urgent problems. We're also in a completely new geopolitical and security situation. We suddenly need to transform the military from an expeditionary force accustomed to sending our soldiers to fight far away to a territorial defence that must defend our territory. So it's very much about finding solutions to the urgent situation. I think there's a lack of long-term thinking. What happens when the war in Ukraine ends? Then what? What kind of military do we need? Not just now or in five years but also further into the future. And I don't think we're good enough at thinking about where technology development is heading and how the military can best utilise it.

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Perhaps you can tell us a bit about who decides how the military should spend the billions of kroner allocated by the Parliament? Who are these people? What is their age composition? What are the qualifications of the decision-making group to make the right decisions based on the right grounds in light of technological development and everything we've just discussed?

Andreas Graae, Royal Danish Defence College

One thing is political, meaning it's fundamentally politically driven by how much money should be spent and priorities. But then there are some military assessments, and again, there's a more extensive system and network of people who sit and provide their military assessments. There are people in the Ministry of Defence's Material and Procurement Agency, FMI, who have much more technical engineering knowledge and know the market. They say, "There's this technological development, and these products on the market can solve these problems".

But then there's also a whole team in the Defence Command, the "forligs-kontoret", and the strategic planning and development unit that looks at our needs. And some younger people are well-versed in their field, and they provide some recommendations. Then it's the commanders at the higher levels, and ultimately the top leadership in the military and the service commands, that is, in the Army, Navy, and Air Force commands, who also present their wishes and assessments of what we need most to be able to solve future tasks.

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However, there must be an overarching strategy for what Denmark needs, and then, the pyramid must be worked down, and the funds must be prioritised. Or isn't that how it works?

Andreas Graae, Royal Danish Defence College

It would be very beneficial if that were the case. Unfortunately, not much has been developed regarding an overarching strategy. There's simply a lack of direction and strategic visions for what kind of military we want. How do we want to utilise new technologies such as drones and artificial intelligence? What's the direction? What are the strengths we want to leverage in the Danish military? Also, concerning the opportunities and strengths we have in Denmark, which you also mentioned at the beginning, we're one of the most digitalised societies. We have a growing defence industry, especially in software development. We have large companies like Systematic, which has just landed a billion-kroner contract with NATO to develop command and control systems, battle management systems. We also have companies like Terma that produce software solutions and sensors. We have a growing robotics and drone industry.

Instead of letting the military decide for itself what's best and where technology development is heading, we should be better at leveraging the knowledge in the private sector and industry to develop new concepts and solutions.

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Where does Denmark stand, for example, in terms of using AI in a military context compared to other NATO countries?

Andreas Graae, Royal Danish Defence College

Like many other smaller states, Denmark has taken a somewhat cautious position. We rely heavily on looking at the larger countries. Especially the USA, but also, to some extent, the UK and some of the larger allied countries, and see what they're doing, their developments, and their solutions.

However, we haven't been very good at formulating our strategy for using AI in Denmark. What areas are we looking at? Artificial intelligence can be used for many different purposes, and it offers many possibilities for a military organisation. Some of these are really low-hanging fruit if you utilise them for administration, logistics, maintenance, or recruitment. Artificial intelligence can be used in many ways that make a lot of sense. But it fundamentally requires that we also invest some money in more updated and newer software and IT systems. And unfortunately, the military is severely lagging in this regard. We simply don't have the IT systems and infrastructure to support the utilisation of artificial intelligence across the entire organisation, branches, domains, units, agencies, etc.

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We'll delve into that a bit more later in the podcast. Ethics and morality seem to hold back many politicians when using AI in the military. At least, that's the impression you get as a layman. At the same time, we also know that those we see as our potential enemies, autocracies, don't really have the same scruples about using artificial intelligence. I often hear politicians here at home say that there must always be a human behind "the decision to kill". Is that a hindrance to the use of new technologies in the military? If so, there are probably also some limitations in using the F-35, which, as far as I understand, is packed with the latest software.

Andreas Graae, Royal Danish Defence College

I don't think it's a hindrance to have a fundamental stance that there should be a human behind decisions about killing and matters of life and death. These are general principles for the responsible use of artificial intelligence, which at least all NATO countries and most Western countries have agreed on and signed up to. It's also something we in the West and diplomatic dialogue with other countries, such as China, are trying to find some agreement on. We don't want to completely let go of this and let

robots make decisions on their own about what to attack. That's not the current situation or state of affairs in the military or Western military organisations.

Then there's another aspect, and it could be about how we utilise artificial intelligence in all the links in the chain of processes and decisions that lead to a situation where an attack is made and the “button is pressed”.

As you also touched on, one could say that there are new investments like the F-35 fighter jet, and when we start looking at what's happening in Ukraine and some of the systems being used there, data processing is definitely involved. The entire handling of data and information from the moment it's generated on the battlefield, for example, drones taking pictures and videos, which are then used for target recognition and designation until a human says, here is a legitimate military target, which we attack. In that whole process, artificial intelligence and algorithms are involved in qualifying and assessing where it would be best to attack.

The notion that these are 100% human decisions can be challenged a bit. An increasing degree of machine-generated data and recommendations leads to a human evaluation of these things.

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Andreas, you've previously mentioned that the Danish military produces a lot of data that we don't use. Something you've pointed out in articles. Therefore, you've argued for a more intuitive use of AI in the military, which should make us better and more efficient in carrying out, for example, the so-called Multi-Domain Operations. Where do we stand today in that area? Do we have the necessary resources as we advance in that area? Perhaps you should first explain what Multi-Domain Operations are.

Andreas Graae, Royal Danish Defence College

Multi-Domain Operations, or MDO, as it's also called in everyday speech, is a military concept that NATO has been working on for quite a few years now and has been widely adopted by most member nations. It basically means being able to carry out operations across domains so they become multi-domain operations. This means it's no longer just within, for example, a naval operation. No, drones are an excellent example of this. They can be both large and small and actually be launched from the ground and operate in the air. However, they provide intelligence pictures and situational awareness to those on the ground. It can also be some sea drones launched from a ship but simultaneously offer information that's used by aircraft.

In this way, information is shared across ships, aircraft, and the ground. We're used to working with the three domains: land, air, and sea, but new domains are emerging, such as space and cyberspace, meaning within cyber operations. This also includes computer networks, satellites, etc., which are part of this entire network of information

and data that should ideally be shared as quickly as possible. The goal is to be able to conduct operations that create military effects as promptly as possible, faster than the enemy does, synchronously across these different domains.

And you're asking whether we're utilising this data well enough in the Danish military to do this? And no, we're not right now. And maybe not many others are either because it's relatively demanding. As you can hear, gathering all that data and sharing it very quickly to make decisions that somehow need to go across land, sea, air, and space is quite complex. It requires some computer and IT systems to handle all this data. And the challenge is also that much of this information, typically if it's operational and time-sensitive, is classified. It's not something you can just share over your phones or regular, for example, 3G, 4G, or 5G networks. So, you're dependent on these being closed, military-classified networks that can handle this data. That's also why many are talking about the need to develop "secure combat clouds," that is, cloud solutions where you can lift all that sensitive, classified data into a cloud, but which is secured and encrypted, so no one we don't want to access it can get hold of all this data. And we're not quite there yet. It's something that's being looked at, but it's both something that will cost a lot of money and will be relatively challenging to develop systems and concepts that can fulfil this task.

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Does it require quantum computing?

Andreas Graae, Royal Danish Defence College

I don't know if I would say it's a prerequisite. I think it can be done without it, but it's clear that if we manage to develop a quantum computer in a way that makes it affordable, etc. We start to utilise quantum technology and quantum computing power in these types of systems. It will definitely go significantly faster and provide more computing power. And it will also enable better and more secure encryption.

The challenge is if you imagine a future where quantum technology becomes more widespread, and you can break encryption using quantum technology. You're suddenly very dependent on being able to do quantum encryption so you can secure your systems against this new threat.

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A more advanced approach to combat through AI and other new technologies also requires, as we talked about, a generational composition where the top military leadership understands what's happening at the operational level. Is that transformation process underway, or does the existing military leadership have the qualifications?

Andreas Graae, Royal Danish Defence College

Yes, I believe those at the top of the Danish military certainly have extensive operational experience and an excellent understanding of what it means to lead soldiers in war and make operational, tactical, and strategic decisions. The challenge may be to be aware of the vulnerabilities it creates regarding thinking far enough ahead for the Danish military. When we see warships being sunk by cheap Ukrainian drones in the Russo-Ukrainian war, what does that mean? It certainly presents many opportunities, but it also raises many vulnerabilities and concerns about protecting our ships against these new threats, such as cheap surface or underwater drones. The same applies to our military installations. How do we protect them against future drone swarms, etc.?

The biggest challenge lies in “imagining something we don't know today”. That's probably the most significant challenge because I think many of those making the decisions, as mentioned before, are top leadership with extensive operational experience, really skilled military personnel making military assessments, etc. But there's a tendency for "today's generals to plan tomorrow's war based on yesterday's experiences."

So, I think there's a certain tendency to look at how the world looks today and how the wars we've fought were and then try to design the future military based on that. And I think the biggest pitfall is not being good enough at imagining that future wars will look significantly different from the ones we've been used to fighting.

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Is there awareness of this issue, both politically and within the military?

Andreas Graae, Royal Danish Defence College

I think there's increasing awareness of it. You can also feel goodwill and interest in "strategic foresight." It's not a new concept, but something the Americans have been very good at working on, especially in the American intelligence communities and politically, after September 11th, when the 9-11 Commission's report evaluated the entire process that led to the terrorist attacks on the World Trade Center.

One of the things they concluded was that the biggest mistake was a "failure of imagination." That is, there was a lack of imagination to see it coming. Therefore, much work has been done on improving this creative imagination to foresee threats that you don't necessarily have on your radar. You can also see this now in Denmark, where there's more focus on working within this idea of trying to imagine what you can't imagine. This also applies when discussing technological development, artificial intelligence, quantum technology, etc. More work is being done on technology radar, horizon scanning, and looking at what might come to have a disruptive impact on the way we conduct warfare today.

I think work is being done in that direction, but the question is whether we're good enough, even at the highest leadership levels, to consider in this way and have an open mind and a creative enough imagination to see what we do 20 years from now when we can no longer use the systems we have today because something has rendered them obsolete.

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Now we've focused on this topic.

Let's end with the final part of this podcast, namely how Denmark should build a more advanced technological military capacity. So far, we've been mainly dependent on military equipment from the USA and military intelligence. Russia's invasion in February 2022 has shown that it's also necessary to have local and adaptable production of military equipment. In Ukraine, it has been especially possible to use drones because the Ukrainians were already advanced in both hardware and software before the war. Do we in Denmark have sufficient capacity to meet the needs of future defence, or will we continue to rely on the USA?

Andreas Graae, Royal Danish Defence College

I think there's at least a tradition in Denmark of making ourselves dependent on the USA. This also has to do with the strategy of purchasing from those we want to be on good terms with and with whom we wish our systems to communicate. So, there's at least also this aspect of interoperability, that is, that you need systems in NATO that can talk to each other.

The question is, now we're starting to look more and more...there's a major transformation happening in Europe, where we're also focusing more on a European defence industry. We're also seeing that there could be some advantages to making ourselves less dependent on Americans.

Also because we've seen that we can't necessarily be 100% sure that we can rely on the Americans in NATO and to help us when the going gets tough. There's an increasing awareness that the whole issue of Russia is our problem, which Europe must solve on its own. So I think you can at least see a growing defence industry in Europe and also in Denmark. Maybe we're beginning to coordinate more towards finding European technological solutions to our needs.

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You already mentioned some Danish companies, but who should be responsible for developing innovation and future military equipment? Has the Danish military collaborated with universities and has the military provided the economic conditions to create an ecosystem for Danish companies in the defence industry or those indirectly linked to the defence industry?

Andreas Graae, Royal Danish Defence College

There's at least a political ambition and will for that to happen. We need to get better at creating this ecosystem. It's also called triple helix collaborations, this triangle between the military, industry, and universities. You can see examples of this happening, and it's happening a lot. Not least, there's been a lot of change in terms of mentality, with more significant goodwill in the population and companies and universities to cooperate with the military.

I think at least some companies are calling for a willingness from the military to give something back the other way. Companies and universities need insight and access to the knowledge and data the military holds to develop solutions and systems that help the military. There's probably still a history and culture of the military being reluctant to share too much of its sensitive and classified information with others. They at least don't want to relinquish control and ownership. That's also one of the problems when we talk about the increasing influence and power of private companies, such as the big tech companies like Microsoft, Google, Elon Musk with Starlink, Palantir etc.

Technology giants are coming in and gaining much greater power because they start developing solutions, but where they also, in a way, own the data they gain access to. Then, we in Western democracies become super dependent on them. So it's a question of whether there's a certain reasonable or healthy restraint from states and military organisations in wanting to relinquish 100% control over the information, knowledge, and data they possess.

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Let me end with the final question. In Europe, several pension funds have begun to remove the "moral hat" when it comes to investments in the defence industry. This is because investing in equipment that can defend us against external enemies, such as Russia, is now considered necessary.

As a conclusion to this podcast, it would be interesting to hear which technological companies in Denmark or Scandinavia are producing software and hardware that is increasingly considered dual-use. You've mentioned some, but are there any on the periphery?

Andreas Graae, Royal Danish Defence College

I mentioned the significant players in Denmark, such as Systematic and Terma. Systematic is an example of a company that produces software solutions within both the healthcare sector and the security and defence sectors. We're also seeing a growing trend where many drones are an excellent example of dual-use technology that can be used for civilian purposes and emergency response, rescue operations, searches, coast guard, etc. It's not necessarily about killing people but also about, for example,

monitoring the Arctic and creating jobs, as well as helping with new technological solutions to support civilian rescue operations, etc. Many examples of companies developing solutions can be used for both purposes. Many of the solutions coming out in areas like artificial intelligence and software have the potential to be used for both peaceful and civilian purposes as well as military purposes, ultimately saving lives.

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Thank you very much for your time, Andreas. You've certainly made me much wiser about the challenges facing the Danish military regarding the use of technology in the military domain.

Andreas Graae, Royal Danish Defence College

It was a pleasure.