Awti Advisory council for science, technology and innovation

KNOWLEDGE OFFENSIVE FOR DEFENCE

RESEARCH AND INNOVATION FOR A SECURE NETHERLANDS

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The Dutch Advisory Council for Science, Technology and Innovation (AWTI) publishes solicited and unsolicited advisory reports to the Dutch government. Its independent reports are strategic in nature and focus on the contours of government science, technology and innovation policy. Council members are drawn from knowledge institutes and the business world. AWTI's work is founded on the principle that knowledge, science and innovation are vital for the economy and society, and will become more important in the future.

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Knowledge offensive for defence

Research and innovation for a secure Netherlands

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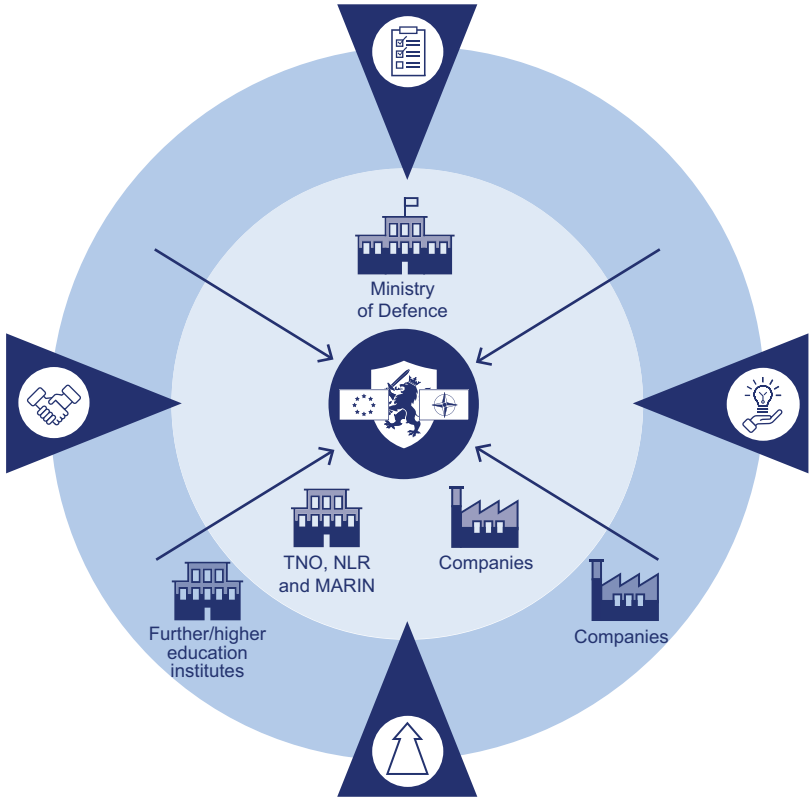


Summary

Peace is not something that can be taken for granted. A conventional war is raging once more on Europe's eastern borders, bringing a palpable threat to the European continent. At the same time, the North Atlantic Treaty Organization (NATO) relies heavily on the military power of the United States (US), a dependence which makes Europe vulnerable. The Netherlands, for its part, has for many years been cashing in on the so-called 'peace dividend', and is now unable to meet its own security needs unaided. New geopolitical shifts are also creating a growing need for European strategic autonomy in defence. The combination of conventional warfare and hybrid threats is also blurring the boundary between peace and war, creating the potential for society as a whole to become drawn into conflict.

All this means it is becoming more difficult to predict what form conflicts will take in the future. Technology is developing at breakneck speed, including in the field of defence. If the Netherlands wishes to be able to work for peace, it will also be necessary to link defence research and innovation to this new reality.

After many years of cuts in defence spending, the increased threats have prompted a renewed upsurge in investment at both European and national levels. This will lead to a more effective European contribution to defence within NATO. It will also have an impact on the research and innovation budget of the Dutch Ministry of Defence. Accordingly, in this report the Advisory Council for Science, Technology and Innovation (AWTI) examines the following request for advice:

How should the Netherlands configure its defence research and innovation efforts (in terms of focus, organisation and the link between military and civil)*?*

Recommendation: Mobilise the entire knowledge ecosystem for defence research and innovation

AWTI sees a number of opportunities for improving the contribution by Dutch research and innovation to strengthening security in the Netherlands and the position of NATO, whilst also reinforcing the strategic autonomy of Europe. The Dutch strength in research and innovation could be deployed more effectively if greater control and steering capacity were handed to the Ministry of Defence. The 'priority areas' (*focusgebieden*) announced by the Ministry in its Letter to Parliament in May 2024 are a step in the right direction here. Bottom-up initiatives will also need to be encouraged in order to make optimum use of the innovation potential of the Netherlands. This will require scouting by the Ministry of existing bottom-up initiatives and the capacity to absorb the knowledge gained into the research and innovation ecosystem. AWTI also believes that the innovation policy of the

Ministry of Economic Affairs and the Ministry of Defence should take more account of the special nature of the defence market and sector. Finally, good cooperation between education and knowledge institutes and the Ministry of Defence offer many opportunities for all stakeholders. We therefore recommend mobilising the entire knowledge ecosystem around defence research and innovation.

Four recommendations to mobilise the entire knowledge ecosystem more effectively

AWTI makes four recommendations to facilitate an optimum contribution to strengthening Dutch security within a stronger NATO whilst fostering greater strategic autonomy for Europe. The recommendations are aimed at several parties: the Ministry of Defence and the Ministry of Economic Affairs, as well as further and higher education institutes. Our recommendations relate on the one hand to expertise in specific knowledge and innovation domains where the Netherlands can make a difference, and on the other to the development and utilisation of a sufficiently broad knowledge base. This will create the future-proof knowledge ecosystem that is needed to meet the challenges presented by technological developments, geopolitical shifts and new types of threat.

Recommendation 1: Focus resolutely and systematically on a small number of areas in which the Netherlands can make a difference (within NATO/EU)

The Netherlands is too small to address every knowledge and innovation need, and will therefore need to focus systematically on areas where the Netherlands can make a difference. This systematic approach begins with coordination at NATO/EU level and ends with the development of roadmaps which provide clarity for Dutch stakeholders. The Ministry of Defence has recently taken positive steps in this direction with the formulation of its ‘priority areas’. In addition, AWTI recommends the following actions:

- Action 1. Define a rolling strategy which makes clear which capabilities[1] are needed now and in the future at EU and NATO level.
- Action 2. Translate the required capabilities from the rolling strategy into knowledge and innovation needs and use an assessment framework to determine the areas to be targeted by the Netherlands.
- Action 3. Develop roadmaps for the areas on which the Netherlands wishes to focus.

1. Capabilities can also be referred to as capacities or military strengths. The term is generally used to mean the degree to which an army is capable of achieving certain military objectives. This can be through the deployment of weapons, but non-technological aspects such as organisation and logistics also play a role.

Recommendation 2: Create scope for bottom-up initiatives across the entire knowledge ecosystem and the defence organisation

The knowledge base needs to be sufficiently broad to keep pace with developments and be able to scout new fundamental scientific research and relevant developments in civil society. Assessing the value of fundamental knowledge and the ability to scale its application following a successful pilot also requires sufficient absorption capacity within the defence organisation. AWTI recommends the following actions:

- Action 1. Organise and strengthen the scouting of fundamental research and of civil developments with defence potential.
- Action 2. Embed innovation across the entire defence organisation to boost absorption capacity.

Recommendation 3: Develop appropriate innovation policy for the defence sector

The third recommendation is directed towards the Ministry of Economic Affairs in collaboration with the Ministry of Defence. The latter Ministry has proven experience and success with public-private partnerships, as in the 'Nederland Radarland' platform. However, the defence market has a number of specific characteristics which makes entry more difficult for companies. AWTI accordingly recommends that the policy be adapted to boost innovation in the defence industry. AWTI recommends the following actions:

- Action 1. Strengthen public-private partnerships in research and innovation.
- Action 2. Foster the development from SBIR (Strategic Business Innovation Research) to SDIR (Strategic Defence Innovation Research).
- Action 3. Open up access to test facilities.

Recommendation 4: Forge reciprocal agreements on sustainable collaboration with education and knowledge institutes

The fourth recommendation is aimed at further and higher education institutes, the Ministry of Education, Culture and Science and the Ministry of Defence. The Ministry of Defence already collaborates intensively with top applied research institutes (TO2 institutes), but would benefit from a greater variety of partners in addition to these 'usual suspects'. AWTI recommends an ongoing dialogue between further and higher education institutes and the Ministry of Defence in order to establish sustainable collaboration in education and research. A positive outcome of this dialogue could moreover create a useful template for other knowledge institutes. AWTI recommends the following actions:

- Action 1. Organise a dialogue within individual knowledge institutes around potential participation in defence-related research.
- Action 2. Encourage knowledge institutes to work with the Ministry of Defence to explore the required parameters for defence-related education and research, and lay down mutual agreements in a national guideline.
- Action 3. Ensure that civil and defence-related educational ecosystems reinforce each other.

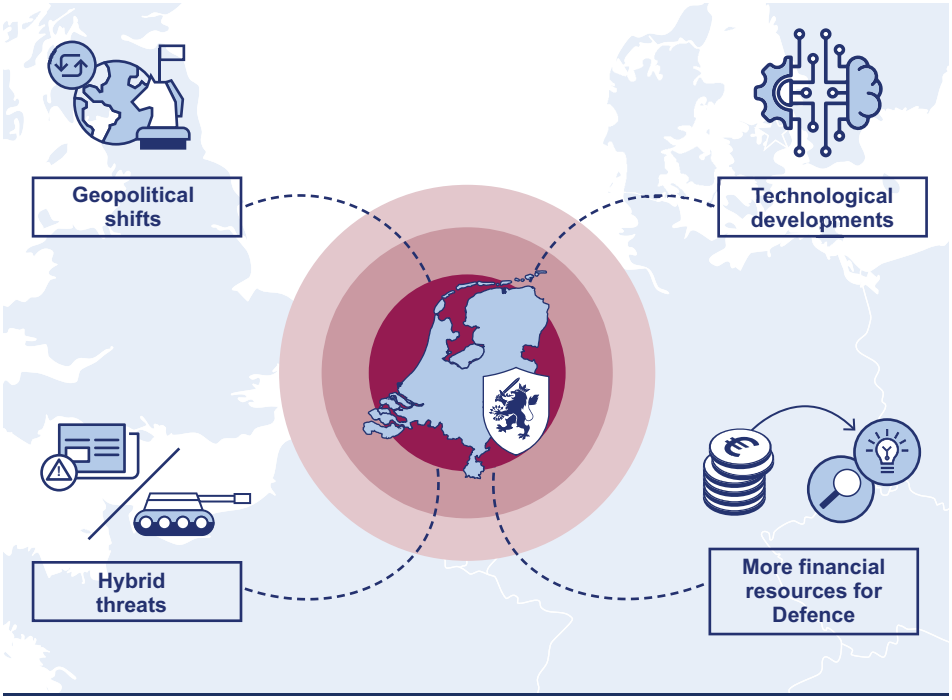
2

Background: Changing conflict requires recalibration of defence research and innovation

With war raging in Ukraine, more and more people are coming to realise that peace is not something that can be taken for granted. But other changes are also taking place which are putting pressure on the security of the Netherlands: technological developments and the increasingly hybrid threats are blurring the boundary between war and peace and making it ever more difficult to predict what form 'conflict' will take in the future. It is in this grey area between war and peace that actions such as cyber attacks and disinformation campaigns are deployed, making it seem that ensuring national security has become a task for everyone in society. The conventional war taking place on Europe's eastern borders further exacerbates this hybrid threat. At the same time, geopolitical shifts are creating a growing need for a strong European defence, and European strategic autonomy is therefore of great importance. Hence, for the first time in many years, extra money is being invested in defence at both European and national level. These changes mean the Dutch Ministry of Defence needs to reshape the focus and organisation of defence-related research and innovation.

Chapter 1 outlines the context in which the Ministry of Defence operates, by looking in more depth at the relevant geopolitical shifts, relevant technological developments, growing hybrid threats and increased financial resources (figure 1). Section 1.3 summarises the current defence knowledge and innovation ecosystem. In this report, the Advisory Council for Science, Technology and Innovation (AWTI) focuses on the following question: How should the Netherlands configure its defence research and innovation efforts?

Figure 1. Changing context is putting the security of the Netherlands under pressure



1.1 Geopolitical shifts are putting the security of the Netherlands under pressure

In the years after the Second World War, a liberal international order of nations emerged, in which the United States (US) played a leading role as a superpower. Under the influence of the American hegemony, a collaboration arose between countries which pursued the ideals of a 'free world'.[2] This led to the formation of the United Nations, the International Monetary Fund, the North Atlantic Treaty Organization (NATO), the (precursor of) the European Union and the Organisation for Economic Co-operation and Development. Later, a Western order of liberal democracies emerged, based on a free

2. Richter, (2019).

market economy protected by an international rule of law. Following the end of the Cold War, there was a belief that most countries would sign up to this order.[3]

However, the world order developed differently. China, a single-party state with an authoritarian regime, grew after the turn of the millennium into an economic, technological and military power. And in recent years Russia has become a largely undemocratic, authoritarian-led state which is not afraid of aggression, as demonstrated by the annexation of Crimea and the invasion of Ukraine. At the same time, the attitude of the US is changing, with more emphasis on protecting its own interests and a reduced willingness to protect the international order which it initially helped to create. This is evident, for example, from the divisions in the US Senate regarding support for Ukraine.[4] We now find ourselves in a multi-polar world, in which powerful nations and blocs compete with each other for power and hegemony in what they regard as their sphere of influence.

These developments are undermining the legitimacy and therefore the influence of the institutions forming part of the liberal order of partner states, such as the United Nations and the European Union. This in turn leads to increased threats, for example because states feel less bound by multilateral arms control agreements.[5] That then puts pressure on independent verification mechanisms such as the International Atomic Energy Agency and the Organisation for the Prohibition of Chemical Weapons. These changes can also pose a threat to national security interests.[6]

All this has increased the importance of Europe's strategic autonomy. The Covid pandemic exposed the vulnerability of supply chains in which we are dependent on other countries. This danger of dependencies also became clearly visible when Russia invaded Ukraine: many European countries were dependent at that time on Russian gas, making it more complex to punish Russia by imposing sanctions. Geopolitical tensions put further pressure on these dependencies. Russia's invasion of Ukraine has made armed conflict in Europe a reality. Moreover, the different geopolitical power blocs are competing with each other for (international) influence, a battle which is being fought among other things in the technological and economic sphere. Not only is a country's economic earning capacity tied in with its technological superiority, but there are also direct security considerations at stake. The armed forces of the future will be dependent on new

3. The best known example of this idea can be found in the book 'The end of History and the Last Man' by Francis Fukuyama.
4. Euronews (2024).
5. Minister van Justitie en Veiligheid en minister van Buitenlandse Zaken (2023).
6. Ibid. In addition, the six national security interests of the Netherlands are set out in the National Security Strategy from 2019, viz.: territorial security; physical security; economic security; ecological security; political/social stability; and the international rule of law.

technology which offers an advantage against the opponent. Europe, including the Netherlands, has long been able to shelter under the wings of the US, but that too cannot so readily be taken for granted today, with the US focusing heavily on its military and economic competition with China.

Taken together, these changes create a growing need for Europe to adopt an independent position in defence, and thus strategic autonomy. European strategic autonomy relates to commodities and critical materials, but also to protecting assets by means of an effective European defence structure. The aim is to ensure European sovereignty by reducing dependencies on non-EU countries and taking more responsibility for its own security.[7]

European strategic autonomy in defence

It is not always clear precisely what is meant by 'strategic autonomy' in a military context. Some EU Member States see strategic autonomy as a means of becoming less dependent on the US; others see it more as an opportunity to increase the attractiveness of EU Member States as NATO partners.[8]

Regardless of the interpretation chosen, European strategic autonomy is necessary to protect Dutch assets, though not necessarily using violence. The idea is that a strong defence acts as such a strong deterrent that it prevents violent escalation. 'Si Vis Pacem Para Bellum', as the Latin proverb runs: 'If you want peace, prepare for war'. In addition to defence, development cooperation and diplomacy are important tools for avoiding and resolving conflicts.[9] Despite the increased geopolitical tensions, the Outline Agreement published by the coalition government in May 2024 announced cuts to development cooperation spending.[10] This implicitly places the emphasis on military capability, with a bigger role for coordination, interoperability[11] and joint procurement of weapons systems. When purchasing weapons systems, countries will need to weigh up the pros and cons of potentially cheaper, off-the-shelf American products versus investing for the longer term in European developments. This judgement thus impinges on the strategic autonomy of Europe.

7. Europese Raad (2022).
8. Zandee et al. (2020).
9. Theunissen (2024).
10. Hoofdlijnenakkoord 'Hoop, Lef & Trots' van PVV, VVD, NSC & BBB.
11. Interoperability is the sharing of data between weapons systems from different countries, for example the ability to send information on targets from a French reconnaissance system to a Polish tank.

The European Commission and the European Council are taking steps to develop the European section of NATO further. The EU has for example compiled a 'Strategic Compass' to strengthen the security and defence of the EU. The Compass deals with all aspects of security and defence policy and is based on four pillars: cooperation against common threats; rapid and decisive action in times of crisis; investing in capabilities and technologies; and protecting against threats and protecting EU citizens. The Compass formulates a common strategic vision and concrete recommendations to achieve the goals within five to ten years.[12] A European Defence Fund (EDF) was set up in 2014 with a budget of EUR 8 billion for 2021-2027, and a Permanent Structured Cooperation platform for defence and security (PESCO) was created to support the European defence industry.[13] More recently, the European Defence Industry Strategy and the European Defence Industry Programme were presented by the European Commission (EC).[14] These initiatives also take the NATO Defence Planning Process into account, as many relevant capabilities are identified by both the EU and NATO. As early as 2003, a NATO-EU capability group was formed to ensure the coherence and mutual reinforcement of both organisations, with the aim of plugging capability gaps. This link between the EU and NATO is important in enabling the EU to be an attractive partner within NATO.

The steps taken by the EU and NATO at international level, in partnership or individually, are of great importance for the defence of the Netherlands and also for innovation in this field. First and foremost, some of these initiatives will lead to additional financial resources being made available for (defence-related) knowledge institutes and innovative companies. Above all, however, the Netherlands is in a position to contribute to European strategic autonomy by delivering high-grade knowledge, technology development and innovations.

1.2 Conflict is changing: technological developments and hybrid threats

Another factor which underscores the importance of defence research and innovation is how actors engage in mutual conflict, and in which arena. Which are subject to change, partly due to technological developments, with inventions from both the military and non-military domain (dual-use) finding their way to the battlefield. At the same time, conflicts are being fought out in an ever increasing number of arenas, such as the digital domain or space. The threats (and conflicts) are accordingly increasingly 'hybrid' in nature, with state and non-state actors working together and combining the deployment of several

12. European Union (2023).
13. See https://www.consilium.europa.eu/nl/policies/defence-security/#compass
14. European Commission (undated); European Commission (2024a).

instruments simultaneously, for example traditional warfare alongside the dissemination of misinformation. Although changes in the nature of conflict are difficult to predict, the way we think about the future of conflict has consequences for the focus and configuration of defence research and innovation.

Technological developments

As noted above, technology plays a role in military superiority. It influences the way in which conflicts are prosecuted. The war in Ukraine has featured the large-scale deployment of new technologies, such as drones, alongside the continuing use of traditional warfare tactics.[15] Artillery still plays a decisive role, for example. This makes it difficult to predict what form future conflicts will take. One thing however is certain, namely that conflicts transform and that new technologies of the future will play a key role in this transformation. This is relevant for the configuration and focus of knowledge development and innovations for defence.[16]

Technologies are being identified at NATO, European and national level which are expected to be relevant for both civil and military purposes. NATO has identified a number of emerging and disruptive technologies on which it wishes to focus specifically in defence research and innovation: artificial intelligence; autonomous systems; quantum technologies; biotechnology and human enhancement technologies; space; hypersonic systems; new materials and production methods; energy and propulsion; new-generation communication networks.[17] To be able to meet China and Russia head on in a technological battle, NATO must promote innovation and support member states to engage in agile and strategic cooperation focused on new technologies. By creating the NATO Innovation Fund and the Defence Innovation Accelerator of the NATO (DIANA) the NATO has made major strides towards achieving this.

The European Commission (EC) has also identified a number of emerging and disruptive technologies in the defence field: quantum-based technology; artificial intelligence; robotics and autonomous weapons systems; big data analytics; hypersonic weapons systems and space technology; and new advanced materials.[18] The EDF allocates 4-8% of its annual budget to emerging and disruptive technologies.

The Netherlands has had a National Technology Strategy (NTS) since the start of 2024. It encompasses a wide array of technologies, chosen from a broad, national perspective based only partly on security and potential military relevance. The selected areas are

15. The Economist (2023).
16. Cats (2023).
17. See https://www.nato.int/cps/en/natohq/topics_184303.htm
18. Clapp (2022).

accordingly not necessarily the most militarily relevant technologies, but they do all have potential military applications. The ten priorities in the NTS are: optical systems and integrated photonics; quantum technology; process technology; biomolecular and cell technology; imaging technology; mechatronics and optomechatronics; artificial intelligence and data science; energy materials; semiconductor technologies; and cybersecurity technologies.[19] It is clear from this list that there is a degree of overlap between the technology areas identified by NATO and the EC and those in the NTS. This overlap is positive, given that warfare and geopolitics in the future will be heavily determined by technological leadership.

Technological developments in the listed strategies move at an increasingly fast pace. The situation in Ukraine has for example resulted in new weapons and technological applications being deployed in the battlefield immediately, without first being tested in a controlled environment.[20] This applies for new technologies such as Delta, for example, a digital networking system which makes it possible to share information about enemy troops with officials, military personnel and selected civilians.[21]

There is also a major flow of technology from the civil to the military domain. For example in drone development, where drones receive weekly software updates sent to enable them to identify targets.[22] The deployment of this kind of 'cheap tech' on the battlefield, with products (here: drones) developed in the civil domain being used for military purposes, demands creative and innovative solutions in defending against attacks. The radars in the Dutch Robin Radar system are for example suitable for studying the movement of drone swarms, which are relatively cheap and simple, while Delft Dynamics is developing drones which can capture other drones. These innovative solutions are necessary to protect against cheap tech, and the development of these solutions means thinking beyond traditional weapons and missiles. It is for example perfectly feasible that an actor who has a circular energy source at their disposal will have a considerable advantage during a military operation, in part because it is no longer necessary to consider the supply and transport of fuels.

Technological development in the defence field moves at breakneck speed and the boundary between military and civil technology is becoming blurred. Focusing exclusively on developing technologies in the defence domain is therefore no longer sufficient for the longer term. Keeping track of current technological developments requires the development of new applications in the short term and involving the civil domain.

19. Minister van Economische Zaken en Klimaat (2024).
20. Schuster (2024).
21. Jakes (2022).
22. The Economist (2024).

Hybrid threats

Conflicts are changing not just because of the technological progress which is transforming traditional warfare, but are also becoming increasingly 'broad' as countries (threaten to) undermine our national security without engaging in direct armed conflict.[23,24] Bad actors can attempt to damage the economy by restricting or denying access to currency or critical raw materials, but also more strategically by not sharing or withholding certain knowledge. Different kinds of threats can be combined and state and non-state actors may sometimes work together. Examples include weaponising immigration by deliberately sending refugees to Europe's external borders, or online tactics such as disinformation and propaganda intended to influence public opinion.[25]

Attempts are made at social disruption by reinforcing existing polarisations and trying to spark 'culture wars'. For example, in addition to waging a conventional war with Ukraine, Russia is heavily involved in hybrid attacks and cyber hacks targeting Europe. If a cyber war is regarded as hacking online networks, a culture war goes a step further, by hacking the people using these networks. People's 'likes' and 'shares' are used to make a certain narrative go viral to ensure it reaches a wider public, for example in order to sow seeds of doubt. Intelligence services now also use this tactic.[26] This expansion of the domains targeted by threats makes the boundary between peace and war more diffuse.[27]

Hybrid threats are not new: propaganda and espionage have also been used in the past. However, the globalisation of economic chains and the increased technical ability to exert influence remotely (e.g. via the Internet) mean that new 'threats' have grown in importance alongside physical warfare. This shift means that conflicts are changing and that economic, social and political dimensions are more often impacted. The fact that war no longer takes place only on the battlefield, but also on computer screens (disinformation), in people's homes (energy) or in knowledge institutes (knowledge security) begs the question as to what extent war is an exclusively military phenomenon or whether it is something that involves the whole of society. The term 'whole-of-society' approach is accordingly used in the context of hybrid threats (see Box).[28,29] A whole-of-society approach involves cooperation between all relevant actors, including civil-society organisations, companies and knowledge institutes. Steps are being taken at NATO, EU and national level to define a whole-of-society approach. Given their history, countries like

23. Analistennetwerk Nationale Veiligheid (2022).
24. Adviesraad Internationale Vraagstukken (2024).
25. Minister van Justitie en Veiligheid en minister van Buitenlandse Zaken (2023).
26. Keulen (2021).
27. Robinson (2022).
28. NATO (2021).
29. Wigell, Mikkola & Juntunen (2021).

Finland, Norway and Sweden have a longer tradition of this approach, whereas it is a fairly new concept for the Netherlands. Finland retained its whole-of-society approach after the end of the Cold War because of its long land border with Russia. The Netherlands recently introduced the Dienjaar Defensie initiative, in which young people can volunteer to spend one year learning new skills in the armed forces, and there are plans to canvass 17 year-olds to consider a career in the military.[30,31] The aim is not only to recruit new military personnel, but also to raise public awareness of defence so that people become more imbued with its importance. The hope is that this will lead to the greater societal resilience needed to resist complex and interwoven hybrid threats.[32]

France adopts an overarching approach to defence and security

The French approach to defence is set out in the *Revue Nationale Stratégique* (RNS).[33] This document presents the main outlines of the French defence structure for the coming years and serves among other things as a strategic framework underpinning the new *Loi de Programmation Militaire* (LPM), which sets out a multi-year programme for national defence.

The most recent RNS, from 2022, contains an analysis and describes challenges and objectives. The starting point is the new geopolitical situation, which provides a basis for discussing not just military or technological aspects, but also economic and civil factors. For example, France will need to adapt its economy to support the new efforts required of the defence industry, and the document also refers to promoting a permanent defence mentality in both society and government. This is in the interest of a united, resilient and robust France which is able to deal with different forms of conflict, including cybersecurity, disinformation and competition for raw materials.[34]

One outcome of the RNS is that the civil sector has been explicitly incorporated in the LPM, with software companies being made jointly responsible for strengthening cybersecurity, for example. They are required to inform the French Cybersecurity Agency (ANSSI) of any significant vulnerabilities in their products or if a notable IT incident occurs which has consequences for national security.[35]

30. Rijksoverheid (2024).
31. RTL (2024).
32. Adviesraad Internationale Vraagstukken (2024).
33. General Secretariat for Defence and Nationale Security (2022).
34. Idem.
35. Ministry of the Armed Forces (2023).

France thus takes a broad view of defence, which is emphatically linked to domains such as cybersecurity, and to economic and societal resilience.

1.3 The Dutch knowledge and innovation ecosystem for defence

The contribution of knowledge and innovations to the civil and military domains is not something that can be taken for granted. A characteristic of research in Europe is the relatively strict separation between civil and military research, unlike countries such as the US and China, where the two domains are more closely interwoven. The National Research Council in the US was for example founded in response to the increased need for scientific and technical services in the wake of the First World War.[36] American universities still have close links with the defence industry, for example through the Defence Advanced Research Projects Agency (DARPA), which finances military and dual-use research. And the links between Chinese universities and the Chinese military are well known.[37] The separation between civil and military research that is common not just in the Netherlands but also in other European countries forms obstacles to utilising knowledge from the civil domain for defence and vice versa. This is less relevant in times of peace, but given the present geopolitical situation, this separation is being reassessed in Europe, both in other European countries and in the Horizon Europe programme (section 2.4).[38]

Technological developments and the rise of hybrid threats has led to changes in the Dutch Ministry of Defence knowledge and innovation ecosystem in recent years.[39] There are roughly 22,000 full-time equivalent employees working at around 1,000 companies in the Dutch defence and security sector.[40] The aggregate turnover of these companies rose from EUR 4.7 billion in 2021 to EUR 5.7 billion in 2022 and EUR 7.7 billion in 2023, an increase of 62% over the period.[41] These companies often have civil activities as well. Larger companies dominate the market, with 20% of companies operating in the defence industry accounting for 85% of turnover.[42] The defence and security sector is generally technologically advanced and knowledge-intensive, with companies investing an average

36. Godin (2017).
37. The Australian Strategic Policy Institute (ASPI) has even designed a tracker to visualise these links. See https://unitracker.aspi.org.au/
38. See European Commission (2024), in which several options are explored for funding dual-use research in the future.
39. Rathenau Instituut (2019).
40. Adviesbureau Berenschot (2024).
41. Idem.
42. Idem.

of 11% of their turnover in R&D.[43] There were roughly 5,600 full-time equivalent employees working in R&D-related roles in the defence and security sector in 2023.[44]

Examples of large companies in the Dutch defence and security sector include Thales (formerly Hollandse Signaalapparaten, now part of the French Thales Group) and the shipbuilder Damen Shipyards Group. The sector also contains a large number of start-ups and scale-ups, such as Delft Dynamics and Robin Radar. The innovation and knowledge ecosystem is completed by knowledge institutes, where a distinction can be drawn between top applied research institutes (TO2 institutes) such as TNO, NLR and MARIN, and public knowledge institutes (universities of applied sciences and research universities).[45] TNO, NLR and MARIN have a tradition in military knowledge development and are an important element in the 'golden triangle' of government, knowledge institutes and industry.[46] TNO has a Defence, Safety and Security Unit which focuses on five areas of research: human and operational effectiveness; electromagnetics and military operations; acoustics and underwater warfare; autonomous systems and decision support; and protection, munitions and weapons. NLR concentrates on the air force and MARIN on naval research. In addition, the Clingendael Institute and the Hague Centre for Strategic Studies (HCSS) regularly carry out strategic research for the Ministry of Defence in support of policy. The Netherlands Defence Academy (NLDA) is a military academy with a Faculty of Military Sciences (FMW) which carries out research in military studies and military history.

Traditionally, public knowledge institutes such as universities of applied sciences and research universities perform less defence research than the defence-related TO2 institutes listed above. There are differences in how much defence research is carried out between institutes, faculties and research groups. The way in which public knowledge institutes contribute to defence can also take different forms, for example through chairs funded directly, via the NLDA or via TO2 institutes. There are also endowed chairs, for example the chair in War Studies at Leiden University, funded by the Royal Netherlands Society for War Studies (KVBK).[47] Structural financing arrangements are also possible, for example via a covenant to establish collaboration with universities of applied sciences. There is for example a covenant where the Institute for the Built Environment at Utrecht University of Applied Sciences provides the theory teaching while the Genie Defence

43. See https://www.nidv.eu/nieuws/noodzakelijke-opschaling-vraagt-om-passende-maatregelen/. Compare this percentage with the Dutch industrial average of 6.7%.
44. Adviesbureau Berenschot (2024).
45. Rathenau Instituut (2019).
46. Ministerie van Defensie (2021).
47. See https://www.universiteitleiden.nl/nieuws/2020/11/intensievere-samenwerking-om-kruisbestuiving-tussen-universiteit-leiden-en-defensieacademie-te-versterken

Institute (Kenniscentrum Genie van Defensie) provides a secure environment for practical training and research assignments.[48] There are also funded defence-related research programmes at a number of research universities and universities of applied sciences, which may also be funded directly or via the Dutch Research Council (NWO). Some of the research funding for these universities is also routed through calls issued via the National Research Agenda (NWA).

In its report 'Kennis in het vizier' ('Knowledge in the spotlight'), published in 2017/18, the Rathenau Instituut describes the recent history surrounding investments in defence as a key turning point.[49] For the first time in many years, investments are being made with a view to doubling the defence budget over the next ten years. In 2018, the Dutch Ministry of Defence also presented the Defence Industry Strategy, the Defence Cyber Strategy and the Defence Innovation Strategy. Other government ministries are also formulating knowledge and innovation agendas for defence and security, often devoting specific attention to digitalisation and cybersecurity.[50] In November 2020 the Strategic Knowledge and Innovation Agenda (SKIA) 2021-2025 was presented by the Ministry of Defence to replace the SKIA 2016-2020.[51,52]

The large-scale Russian invasion of Ukraine on 24 February 2022 has led to a much more radical change in the policy context for all European countries.[53] During this period, the Ministry of Defence published an Innovation and Research Implementation Agenda and an updated the Defence Industry Strategy.[54,55] The Defence Cyber Strategy has since been replaced by the Defence Strategy for Data Science and AI 2023-2027.[56] And now it has become apparent that the Russia-Ukraine war is likely to be protracted, an Action Agenda has been drawn up for safeguarding the production and supply of munitions and defence equipment. A progress briefing was recently sent to the Dutch House of Representatives concerning the Innovation and Research Implementation Agenda.[57]

International cooperation is playing an increasingly important role in knowledge development and innovation for defence and security.[58] Traditionally, the knowledge

48. See https://www.hu.nl/hogeschool-utrecht-en-defensie-gaan-intensiever-samenwerken
49. Rathenau Instituut (2019).
50. Idem.
51. Ministerie van Defensie (2020a).
52. Ministerie van Defensie (2016).
53. Schulze-Marmeling, Wilke & Wulf (2022).
54. Staatssecretaris van Defensie (2022).
55. Minister van Defensie, Minister van Economische Zaken en Klimaat en staatssecretaris van Defensie (2022).
56. Ministerie van Defensie (2023).
57. Staatssecretaris van Defensie (2024).
58. Ministerie van Defensie (2024a).

ecosystems for defence were more nationally focused and organised, primarily because of the national security and economic interests involved.[59] But international cooperation has increased gradually over recent years. The Netherlands is of course a member of NATO; as well as strategic planning for the required future capabilities, there is also a NATO Science and Technology Organisation within NATO, in which around 5,000 researchers and developers from 40 countries - including the Netherlands – work on research and innovation that is important for NATO. In addition, NATO promotes practicable innovations in the military context via DIANA, to which the Netherlands is also affiliated, and the NATO Innovation Fund, which has around EUR 1 billion to invest in deep tech that is relevant for defence and security.

Over the years, the Netherlands has developed a more intensive cooperative relationship within NATO with partner countries such as Canada, Germany, France, Norway, the United kingdom (UK) and the US. The Netherlands works closely with Belgium in a project for the development and procurement of new Mine Counter Measures vessels and frigates. Cooperation on defence research and innovation is also growing within the European Union following the creation of the EDF. The EDF draws a distinction between grants for research activities and activities focusing on development, with a larger budget being allocated to development than research. It emerged from one of the interviews carried out for this advisory report that the Ministry of Defence also followed this line in 2023 and released more funding for development than research activities.

Knowledge development and innovation manifests itself in various projects, which are often funded nationally or internationally. An example is the National Growth Fund (NGF), which invests in projects that will make the biggest possible contribution to sustainable and structural economic growth. As executive ministry, the Ministry of Defence will oversee the NGF POLARIS programme.[60] The aim of this programme is to bring together different ecosystems in relation to radar, MRI and telecommunications in order to achieve breakthroughs in the field of radio frequency systems. In practical defence terms, this means that a technological basis is being laid for a new generation of radars with greater reach. The POLARIS consortium consists of various kinds of partners, such as knowledge institutes (TNO, Chip Integration Technology Center, Twente University, TU Delft and Eindhoven University of Technology) and industry (Thales, Philips and NXP) up to and including SMEs and regional development corporations (Oost NL, BOM). The NGF has made available EUR 101.7 million in funding.[61]

59. Rathenau Instituut (2019).
60. POLARIS stands for ‘Pathway towards Opportunities for Large scale Applications of Radically integrated systems’.
61. See https://www.nationaalgroeifonds.nl/overzicht-lopende-projecten/thema-veiligheid-en-digitalisering/polaris

An example of a project funded by the EDF is SEACURE.[62] The aim of this project is to develop an integrated system of unmanned platforms to enable joint anti-submarine and seabed warfare operations to be carried out. This will enable critical maritime infrastructure to be protected, such as undersea telecommunication and electricity cables. Many countries are taking part in this project: Belgium, Germany, Finland, France, Greece, Italy, the Netherlands, Norway, Austria, Portugal, Romania, Spain and Sweden. The project coordinator is Thales, which is also taking part in the project with group companies from a range of countries (Thales Nederland is actually not taking part). In addition to various partners from industry, knowledge institutes are also taking part in this project, such as universities of applied sciences and research institutes including TNO, the only Dutch partner in this project. The subsidy from EDF amounts to over EUR 44.6 million.[63]

Dutch partners also participate in various international projects outside the EU, including the Responsive Space Capabilities Memorandum of Understanding, a multilateral partnership between 11 countries: Australia, Canada, Germany, Italy, the Netherlands, New Zealand, Norway, Spain, the UK, the US and Sweden. The aim is to explore the scope for collaboration on research and knowledge-building in a range of fields, such as the military application of small satellites, communication technologies and responsive launch options.[64] The Netherlands is known for the high quality of its space industry and knowledge institutes, such as TNO and NLR. According to the Ministry of Defence, TNO and NLR are internationally renowned in this field, and they are carrying out the research for the Netherlands.[65]

1.4 More financial resources for defence, including for research and innovation

The heightened geopolitical and hybrid threats and the rapid pace of technological developments are leading to a turnaround in the attention and funding for defence. In the 1990s and the first decade of this century, the Netherlands made good on the ‘peace dividend’ by cutting back heavily on defence spending. Further cuts followed the global financial crisis of 2008, with a structural spending reduction of EUR 1 billion being announced in April 2011.[66] The Netherlands was not alone in this: in the period 2009-

62. SEACURE stands for SEabed and Anti-submarine warfare Capability through Unmanned featuRe for Europe.
63. See https://defence-industry-space.ec.europa.eu/document/download/32604a9c-bffa-48ce-905e-86b320b81446_en?filename=EDF-2023-DA-UWW-ASW%20SEACURE.pdf
64. Ministerie van Defensie (2021).
65. Ministerie van Defensie (2022).
66. Algemene Rekenkamer (2021).

2014, many EU Member States reduced their national defence budgets.[67] These long-lasting spending cuts led to the loss of specialist knowledge, for example around knowledge-building, and the absorption capacity needed to translate knowledge into innovation.[68]

It has now become clear to European NATO member states that they need to invest more in defence. In 2014, NATO member states agreed that within ten years they would spend 2% per annum of their gross domestic product (GDP) on defence.[69] Despite this pronouncement, many countries have not yet hit this target; in 2022 only seven of the 29 countries had done so.[70] The Netherlands invested an estimated 1.64% of GDP in defence in 2022. However, the 2022 Defence Memorandum announced a structural increase in defence spending of EUR 5 billion, a 40% increase in the defence budget which would take the Netherlands to just above the 2% target in 2024 and 2025.[71]

The Ministry of Defence has budgeted EUR 21.4 billion in 2024 for material and new projects, compared with EUR 12.9 billion in 2022. It has been agreed within the European Defence Agency (EDA) that at least 2% of defence spending should go to research and technology development.[72] At European level, however, investments in defence mainly prioritise the procurement of equipment, with the focus primarily on technology development and production and less on fundamental research and technology demonstration.[73]

The Innovation and Research Implementation Agenda from November 2022 announced that the Ministry of Defence would invest an additional EUR 46 million in 2023, rising to EUR 77 million in 2026, in long-cyclic innovation.[74] This is defence-specific research and technology development which enables certain military capacities to be achieved in the long term. The additional investments in short-cyclic innovation will rise from EUR 40 million in 2023 to EUR 90 million in 2026.[75] Short-cyclic innovation includes projects to develop civil technologies further for a military context. In 2023, around 1.4%, or roughly EUR 214 million, of the total budget of some EUR 15.3 billion was devoted to defence research and innovation.[76] A large part of this stimulus package will go to TNO, NLR and

67. Keulen (2021).
68. Van Harreveld (2023).
69. It was announced in the government programme that defence spending would be brought into line with the 2% target.
70. NATO (2022a).
71. In practice, the 2% target may not be achieved because the economy may have grown while the amount spent on defence remains the same.
72. Ministerie van Defensie (2020b).
73. European Commission (2024).
74. Staatssecretaris van Defensie (2022).
75. Staatssecretaris van Defensie (2022).
76. Ministerie van Defensie (2024a).

MARIN, the knowledge institutes which carry out statutory knowledge-intensive government tasks for the Ministry of Defence.

1.5 Request for advice: How should the Netherlands approach defence research and innovation?

Technological advances and the rise in hybrid threats are leading to changes in the nature of threats and conflict. These developments put pressure on the defence research and innovation chain to adapt rapidly and operate in new ways which match the changed context and new developments. The growing awareness that peace can never be taken for granted means that, after a number of meagre years, more money is once again being invested in defence, creating a bigger budget for defence-related research and innovation. Accelerating technological developments, the changing nature of threats and conflicts and the desire for European strategic autonomy in defence create a changing reality which requires adaptation of defence research and innovation. AWTI accordingly addresses the following request for advice:

How should the Netherlands configure defence research and innovation (in terms of focus, organisation and the links between military and civil)*?*

Creation of this report

This advisory report was created in a number of steps. The preliminary phase involved a stakeholder and policy analysis. We also conducted interviews with a number of experts (see Appendix 1 for a list of interviewees). We also drew on the Innovation Attaché Network (IA Network) to gather insights by issuing a call for contributions. The analyses were discussed during Council meetings to arrive at a line of reasoning with recommendations. A draft version of the advisory report was submitted to two external reviewers (see Appendix 2), who were asked to reflect on the consistency of the draft report. Any gaps identified were processed under the responsibility of the Council. We would like to thank the reviewers, the IA Network and all interviewees for their time, openness and insights.

Project group

This report was prepared by a project group consisting of Council members Jos Benschop (chair), Chokri Mousaoui and Anka Mulder, and staff members Bart Gulden, Hamilcar Knops and Tara van Viegen.

Structure of this report

Chapter 2 discusses the results of the above analyses and discussions. This shows that the Ministry of Defence has already taken a number of positive steps, but that there is a need to mobilise the knowledge ecosystem for defence research and innovation. Chapter 3 contains four recommendations for developing a future-proof ecosystem for defence research and innovation. By mobilising the entire knowledge ecosystem, the Dutch defence system will be able to make an optimum contribution to a stronger NATO and European strategic autonomy.

2

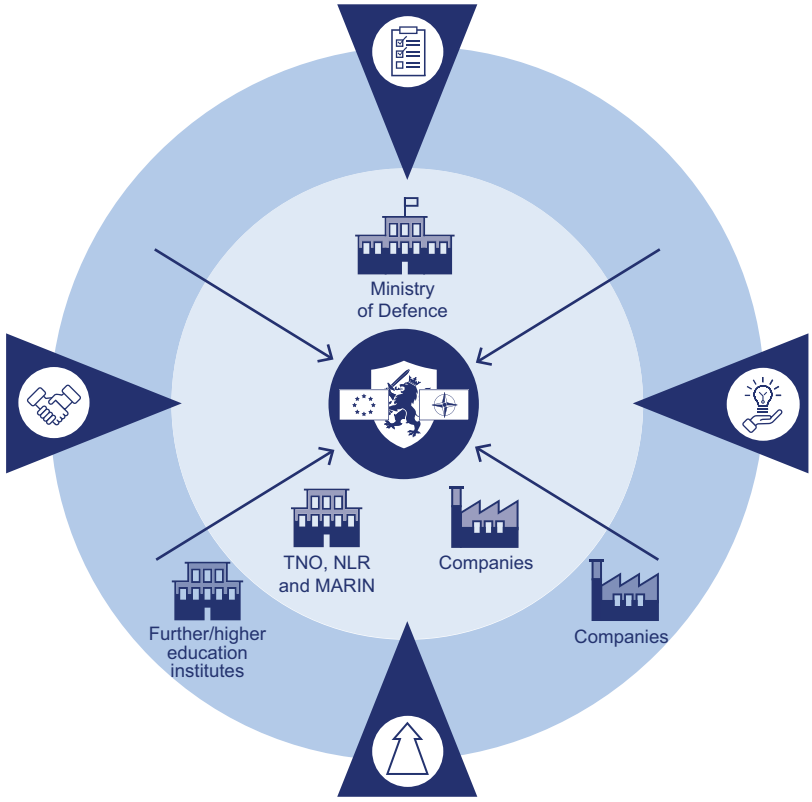
Mobilise the entire knowledge ecosystem for defence

The first chapter outlined the changing context of increased geopolitical tensions, technological and non-technological developments, as well as the increased financial resources for the Ministry of Defence. These changes have forced the Ministry of Defence to reshape the focus and organisation of the knowledge ecosystem.

AWTI advises the Ministry of Defence to mobilise the entire knowledge ecosystem for knowledge and innovation so it is in a better position to develop the required capabilities. By 'entire knowledge ecosystem', AWTI means the combination of the core ecosystem[77] of the Ministry of Defence organisation with its highly defence-focused companies and knowledge institutes, together with the broader knowledge ecosystem incorporating (parts of) organisations which are engaged to a greater or lesser extent in defence research and innovation, but which are or can still be relevant (figure 2). The Ministry of Defence is already taking positive steps to create a future-proof knowledge ecosystem for defence research and innovation which will help strengthen the defence capabilities at NATO, EU and national levels. The Ministry has for example announced a system of priority areas and roadmaps with a view to taking more control over research and innovation needs.[78] Civil solutions are also being scouted, for example via MINDbases[79] around the Netherlands, and collaboration is being sought with other civil partners such as universities (of applied sciences). AWTI believes that additional steps can (and must) be taken in order to mobilise the entire knowledge ecosystem more effectively. In this chapter we present four arguments for this.

77. AWTI regards the knowledge ecosystem as comprising the Ministry of Defence, the defence-related TO2 applied research institutes and companies which already work intensively with the Ministry of Defence.
78. Staatssecretaris van Defensie (2024).
79. MIND stands for Military Innovation by Doing, and a MINDbase is an innovation hub where ideas and products for defence are developed.

Figure 2. Collaboration on defence research and innovation needs to be expanded



2.1 Focus and control needed for Dutch defence contribution in European and NATO context

The Netherlands is too small to have strategic autonomy in defence, and is therefore always dependent on partners and allies. This manifests itself in the first place through membership of NATO; The Ministry of Defence also invests in membership of European initiatives such as EDF and PESCO. The Netherlands possesses high-grade technological knowledge which can benefit other countries and which enables the Netherlands to contribute to the strategic autonomy of the European defence industry, provided there is a demand at the European level for such knowledge and that the Netherlands has something unique to contribute within a particular knowledge field. To

ensure this, the Dutch approach must align with the needs of NATO and the Ministry of Defence must aim to build the specific capabilities that NATO expects from the Netherlands.

The Ministry of Defence has drawn up several strategic policy documents in recent years aimed at future-proofing Dutch defence. These documents set out a vision for the future and describe how knowledge and innovation can contribute to achieving it. These are positive steps, but discussions with those in the field and the findings from our analysis show that there are practical obstacles to implementing this strategic policy: the identified research areas have not yet led to new capabilities, the national knowledge and innovation requirements are insufficiently aligned with NATO and EU requirements, and the policy does not make the innovation requirements sufficiently clear for all stakeholders.

The Defence Vision 2035, published in October 2020, described the ambition of turning the Ministry of Defence into a smart, technologically advanced organisation by 2035.[80] Among other things, the Vision provides frameworks for the procurement of large equipment. In addition, the Strategic Knowledge and Innovation Agenda (SKIA), presented in November 2020, identifies nine Research & Technology (R&T) areas.[81] These areas emerged organically by linking many years of defence research and technology development (push factors) with the knowledge needs of the Ministry (pull factors) and translating them to the operational context. The nine R&T areas are: cyber and electronic warfare; sensor systems; weapons systems; platform systems; command and control; protection; human performance, people and training; autonomous and unmanned systems; and key technologies. SKIA provides direction for research and innovation, but does not lead directly to capabilities in the identified areas.

When it comes to international cooperation, NATO capabilities must be translated into knowledge and innovation requirements at national level. As stated, the SKIA provides direction for research and innovation, but the alignment with the capabilities needs to be strengthened. Our interviews indicated that the Ministry of Defence needs to be given more control and that (smaller) knowledge and innovation partners such as start-ups need better guidance. In response to this, the Ministry of Defence recently designated a limited number of ‘priority areas’ (*focusgebieden*).[82] This is a positive development, because greater direction from the Ministry creates clarity for companies and knowledge institutes, making them more likely to sign up. However, choosing priority areas also

80. Ministerie van Defensie (2020b).
81. Ministerie van Defensie (2020a).
82. Three of these priority areas – quantum, intelligent systems and sensors – align directly with the R&T domains from the SKIA. The other areas – smart materials and space – are identified in the SKIA in the Technology Review, which served as input for the de R&T areas.

creates challenges, such as who makes the selection and which criteria a priority area has to meet. The National Technology Strategy (NTS) of the Ministry of Economic Affairs and the priority areas of the Ministry of Defence could reinforce each other, but our interviewees indicated that the differing underlying perspectives mean this is difficult to achieve in practice. Once the priority areas have been chosen, it must be made clear to industry and knowledge institutes how they can contribute to these areas. Parties with comparable or complementary ideas and plans must be brought together. There must also be sufficient financial resources to enable the Ministry of Defence to steer knowledge development and innovation, and for co-financing of EDF and other projects.

The heightened geopolitical tensions mean that matching the capabilities at NATO, EU and national level is becoming ever more important. Regular and frequent liaison takes place to develop a Dutch Defence Vision from the NATO Defence Planning Process (NDPP). A NATO Defence Planning Capacities Review is also being carried out, describing the extent to which the Netherlands is delivering the capabilities expected by NATO.[83] The Netherlands is used to working with other parties – for example within PESCO, but also through bilateral arrangements – that are familiar partners, but ensuring that the capabilities align with what NATO needs will require more frequent cooperation with less familiar partners.

The Ministry of Defence uses a process comprising a series of steps from vision formation to research and innovation and procurement. This is positive, but the cycle is compromised by being tied to government terms of four years. NATO also uses a four-year cycle to plan capabilities. However, technological developments move at breakneck speed, and a recalibration every four years creates the risk of falling behind. The identification of new technology developments is also not easy to pin down to a four-year cycle. Under the current system, the SKIA is updated every four years, with a focus on the long term. This is supplemented by the development of an annual R&T plan. This plan could be more coherent, and should for example include innovation.

To improve the guidance for research and innovation, the Ministry of Defence intends to develop roadmaps in the future.[84] At present, roadmaps are already used for the Maritime Knowledge Network (Kennisnetwerk Zee), the Nederland Radarland platform and in the Energy Transition for Operational Equipment. A number of observations can be made here. Concepts that are described for the ‘future force’ must be clear and unambiguous, so that the entire organisation can focus on them. This became apparent earlier with the term ‘multi-domain activity’ used in the SKIA; a study by HCSS showed that stakeholders

83. NATO (2022b).
84. Staatssecretaris van Defensie (2024).

interpret this concept in different ways.[85] To avoid confusion, it is therefore important to create clarity around the various concepts.

There is sometimes also a lack of clarity regarding knowledge and/or innovation requirements. For example, identifying a priority area is interesting, but if no knowledge or innovation requirements are subsequently linked to it, this leaves lots of scope for interpretation. It is then insufficiently clear what is expected from knowledge institutes and industry. Detailing specific knowledge or innovation requirements can increase the focus and effectiveness of a priority area. Our interviews showed that the needs of stakeholders differ: large companies often need less guidance than SMEs and start-ups. It is advisable to take this into account when developing roadmaps.

2.2 Promotion of bottom-up initiatives and absorption capacity important for translation and identification of future priority areas

In addition to more focus, it is important that the knowledge and innovation ecosystem of the Ministry of Defence has a sufficiently broad knowledge base to ensure that knowledge, not just from the Netherlands but also from other countries, can be absorbed and translated into national capabilities. To facilitate this the requisite knowledge base must be of a sufficiently high level.

It is also likely that the priority areas of the future will be identified from a broad knowledge base. The recently announced priority areas can for example be traced back to the R&T areas from the SKIA and the technology review which lay at the basis of the push-side of the SKIA (see also section 2.1).[86] This technology review was largely a bottom-up process, driven by researchers from TNO. Technological and non-technological developments cannot be predicted with sufficient accuracy to enable future priority areas to be identified top-down. Sufficient scope therefore needs to be created for innovative industry and higher education and applied research institutes to enable bottom-up initiatives to continue contributing to the identification of future priority areas. In practice, the Ministry of Defence is already taking several steps in this direction, for example by allocating a budget to TO2 applied research institutes to fund ‘free’ research. This enables them to scout fundamental scientific research that contributes to the broad knowledge base described above.

The Ministry of Defence also scouts civil developments which can be rendered suitable for military applications in the short term (short-cyclic innovation), for example via the

85. Ellison & Sweijs (2023).
86. The priority areas are referred to as ‘NLD_areas’ (*NLD_gebieden*) in the appendix to the Letter to Parliament on the progress of the Innovation & Research Implementation Agenda.

MINDbases. This form of scouting does not contribute so much to the broad knowledge base, but mainly strengthens the relationship with companies and knowledge institutes within the broader knowledge ecosystem. The MINDbases focus specifically on start-ups, innovative SMEs and, to a lesser extent, universities. There are MINDbases in Eindhoven, Enschede and Rotterdam in non-military, accessible locations in order to facilitate contact with the regional innovative industry. AWTI regards the MINDbases as an interesting addition to the Ministry of Defence innovation ecosystem. Evaluation together with stakeholders, including in the regional ecosystem, appears to be the best way forward to analyse the impact of MINDbases.

The civil domain in the Netherlands has a great deal of innovation potential, yet applications that could be useful for defence often end up in the 'valley of death'. The transition from successful tests to actual implementation is difficult in practice.[87] In the case of short-cycle projects, the obstacle is often not financial, but rather the limited capacity within the defence organisation itself. This limited capacity mainly relates to the procurement organisation COMMIT.[88] It emerged from our interviews that many companies run up against a bureaucratic wall, for example regarding public procurement rules. The Ministry of Defence is required to adhere to European procurement rules, with the result that a company which is involved in a pilot can be disqualified because it is deemed to have insider knowledge (section 2.3). Our interviews also revealed a certain risk-avoidance culture, which means that familiar or existing options are often preferred to new applications whose added value has been confirmed in a pilot.

2.3 Complexity of defence market means stimulus measures needed

This section discusses a range of stimulus measures by the Ministry of Defence and the Ministry of Economic Affairs. These measures are needed because the defence market is complex and because the measures taken by the Ministry of Defence are focused mainly on companies which contribute to the requisite defence capabilities of the Netherlands. Defence companies can also make use of the innovation policy of the Ministry of Economic Affairs.

Lack of level playing field due to differing support from national governments

The defence market has specific features which can pose an obstacle to Dutch defence companies. The national defence market is a monopsony, with only one buyer (the government) and often several potential suppliers. Internationally, there may be several

87. Bekkers, Bolder & Rademaker (2020).
88. Polman (2024).

buyers, but there is no level playing field here.[89,90] Procurement programmes are governed by mandatory European procurement rules, but national interests mean that Member States apply those rules differently, and sometimes less assiduously.[91] For example, Article 346 of the Treaty on the Functioning of the European Union contains an exemption clause[92] which enables countries to tender outside the European procurement rules where the procurement relates to matters of national security. The Dutch Ministry of Defence has also indicated in numerous policy briefs that it wishes to make more, and more frequent, use of this exemption clause. The impression is that some governments which wish to keep their procurement national and which have a well-developed defence industry make use of this exemption clause more often than other governments. This creates an unlevel playing field in the international defence market.

As well as this difference in interpretation of public procurement rules, there are differences in the rules around export control for military and dual-use products. Legislation and regulations are mainly designed to prevent weapons falling into the wrong hands.[93] However, differences in legislation and regulations and their application in export controls make entry to the international market difficult for companies from countries with a relatively strict export control regime, because companies from such countries are unattractive supply chain partners for companies from countries with less strict export controls. The French-German Declaration of Toulouse was signed in 2019, a binding bilateral agreement between Germany and France in which each country gives up control over the export of jointly produced equipment if it contributes less than 20% to the total. Previously, German companies were less attractive partners for French companies because of Germany's stricter export controls. Prior to this, the Netherlands and Germany had attempted to impose even stricter export controls at European level to prevent weapons from falling into the wrong hands. The French-German Declaration suggests that this attempt failed. Spain and the Netherlands plan to sign up to the 2019 French-German Declaration.[94] This could potentially make Dutch companies more attractive as partners for companies from countries that have already signed up to the Declaration, because they can then apply joint export controls, thus reducing the risks. The countries that have signed up to this Declaration can therefore play a pioneering role. It is however

89. Stichting Nederlandse Industrie voor Defensie en Veiligheid (2021).
90. Militaire Courant (2023).
91. Cohen & Alderman (2024).
92. See https://eur-lex.europa.eu/legal-content/NL/TXT/PDF/?uri=CELEX:12012E/TXT
93. This relates not just to complete weapons, but also to components. For example chips which could be of Dutch origin have been found in Iranian drones being used by Russia in the war in Ukraine. Iran may have obtained the chips by claiming that they were to be used in smart washing machines.
94. Minister voor Buitenlandse Handel en Ontwikkelingssamenwerking, Minister van Buitenlandse Zaken, Minister van Economische Zaken en Klimaat en Staatssecretaris van Defensie (2023).

important to remain alert to new forms of dependence in supply chains which could arise from these agreements.

Finally, there are differences in the support that national governments give to companies, for example in funding research or test facilities. Dutch companies often have to finance the use of test facilities themselves, whereas in some countries the government pays for this. India, for example, has a Defence Test Infrastructure Programme, incorporating the Technology Development Fund, which provides financial support to start-ups and SMEs to enable them to use test facilities.[95] As well as funding, arranging access to the facilities of TO2 applied research institutes is also often difficult and bureaucratic for SMEs.[96]

Instruments of the Ministry of Defence

The Ministry of Defence has a number of instruments at its disposal to stimulate the development of knowledge and innovation in the Netherlands in a complex international market. The government can exercise some control by issuing specific calls and thus giving precedence to developments which reinforce the priority areas. The Ministry of Defence has to date also applied the concept of 'launching customer' in order to organise the 'technology pull'. As a launching customer, the Ministry is the first customer of an innovative company, while the technology pull means that the knowledge requirements of the Ministry take priority. Nederland Radarland is a successful example of the Ministry acting as a launching customer. It also shows how a roadmap contributes to cooperation within the triangle of industry (Thales), knowledge institutes (TNO, TU Delft) and the Ministries of Defence and of Economic Affairs. Our interviewees see potential in wireless optical communication as a forthcoming success story for the Ministry of Defence as a launching customer. The power of this construction lies inter alia in the cooperation between the different branches of the armed forces (Army, Air Force, Navy and space), enabling capability to be developed that is also of interest for other NATO countries and which also provides an incentive to other relevant industries in the Netherlands.

It is however far from certain what form such collaboration between industry, knowledge institutes and the Ministry of Defence could take if there is no original equipment manufacturer (OEM) involved, such as Thales. It takes a long time to set up such a collaboration and participants must have sufficient financial resources to be able to finance it. There are no guarantees that smaller parties will be able to do this. Although the government's position as a launching customer is often cited as an instrument in policy documents for stimulating knowledge development and innovation, its effectiveness depends on the degree to which stakeholders are able to support such an

95. Ministry of Defence (2024).
96. Interviewees cited various practical examples here.

ecosystem. The projects are moreover lengthy, which means it also takes a long time before they deliver fruitful outcomes.

The lack of a level playing field makes it more difficult for Dutch companies to serve an international market. They are therefore unable to upscale, so that potentially interesting (defence) innovation never leaves the 'valley of death'. The thresholds for entry to the defence market can mean that (Dutch) companies focus their attention on civil rather than defence applications. This harms the earning capacity of Dutch companies in the defence industry. To create a more level or fairer playing field, it is often argued that the entry thresholds as described above should be lowered. The question then is whether this ultimately leads to a more level playing field for everyone or merely delivers advantages for Dutch companies. Moreover, the EU is aiming for 40% joint procurement programmes for defence equipment,[97] with a view to promoting interoperability. It is understandable that the Dutch government prioritises instruments which generate benefits for the Dutch defence industry, but it is also desirable to continue considering the European perspective in using policy instruments to achieve a more level playing field. In the recent Letter to Parliament on the Action Agenda for safeguarding the production and supply of munitions and defence equipment, the Ministry of Defence commits to devoting more attention to the European or Dutch origin of products in the procurement of defence equipment.[98]

In a world characterised by ever faster technological developments and the need to collaborate with foreign partners, it is important to have policy instruments which align with this. The 'launching customer' instrument used by the Ministry of Defence does not always match the speed of technology development. The war in Ukraine has shown that technological developments follow each other at breakneck speed (see also chapter 1). For example, unlike traditional equipment, which can sometimes take decades to develop, drones have a much shorter development cycle and need almost weekly software updates during operation. Technology developments thus show a mixed picture of long-term projects with large-scale systems on the one hand and short-term projects to meet acute needs on the other. This creates a need for flexible instruments.

A concept such as 'launching customer' targets companies and knowledge institutes which can meet a need on the part of the Dutch Ministry of Defence. However, a healthy defence industry also needs instruments which encourage companies to work with partner countries to develop capabilities. That not only contributes to employment and

97. European Commission (undated); European Commission (2024a).
98. Ministerie van Defensie (2024b).

earning capacity in the Netherlands, but also makes the Netherlands an attractive collaboration partner within NATO.

Instruments available to the Ministry of Economic Affairs

Like the Ministry of Defence, the Ministry of Economic Affairs also has instruments at its disposal to stimulate the Dutch defence industry. For example, the Commissariat for Military Production (CMP) is concerned with the link between the Dutch defence and security industry as a provider and the Ministry of Defence and foreign defence organisations as buyers. The government can make use of Industrial Participation (IP) here. If the Ministry of Defence places an order of more than EUR 5 million with a foreign company, the CMP can use the IP instrument to ensure that the foreign company places reciprocal orders with the Dutch defence and security industry. These reciprocal orders may also involve knowledge and innovation, for example commissioning research by TNO, potentially generating a higher multiplier for the Netherlands than merely placing reciprocal orders with a producer. Foreign parties could also act as launching customers by investing in Dutch parties.

The interviews conducted for this report signalled a need for a critical review of whether specific instruments are needed to stimulate innovation in the defence industry (section 3.3). It is argued that the Ministry of Economic Affairs needs instruments to stimulate innovative capacity for the relevant defence industry. Dutch defence companies are not always able to compete on price, because of the above-average production costs in the Netherlands; but they can compete on quality or develop products that other countries do not have. Knowledge development and innovation are essential for this.

One way of stimulating knowledge development and innovation is to promote public-private partnerships. The Ministry of Economic Affairs has extensive experience with programmes of this kind through the Mission-driven Top Sector and Innovation Policy, and the Ministry of Defence is gaining experience with them. The public funding for these programmes too, however, is relatively limited and it takes a long time to set up the necessary collaborations. Earlier evaluations of Ministry of Economic Affairs policy instruments for public-private partnerships have moreover shown that it is more difficult for small companies and start-ups to take part,[99] for example because of their limited financial resources and risk-sensitivity, especially compared with larger companies.

Funding obstacles

Funding can also be a challenge in a more general sense for defence-related companies. Both national and international research is accordingly being carried out into the financial needs of the defence industry. Recent Dutch research revealed that 36% of companies

99. See e.g. Dialogic (2021).

experience funding challenges;[100] European research produced a figure of 40%.[101] However, both studies also showed that a high proportion of these companies do not actively seek funding, perhaps because innovative defence companies believe they have no chance of securing it, but also because these companies are able to penetrate sufficient alternative sources of finance. The studies do not provide clarity on this.

Nonetheless, new funding instruments are being set up based on the findings of the research, for example the announcement by the Ministry of Defence and the Ministry of Economic Affairs of a 'Security Fund' in the Action Agenda for safeguarding the production and supply of munitions and defence equipment.[102] This is a revolving fund which is intended as an investment vehicle for start-ups in the dual-use security domain. It was announced that EUR 25 million will be allocated to the Fund, with the ambition of growing further. The Fund has national coverage and spans multiple sectors. The Ministry of Defence is also holding open the possibility of setting up a guarantee scheme for (parts of) the defence industry.

2.4 Collaboration between universities and Ministry of Defence requires a culture change

Given the changing dimensions in which conflicts are fought, it is important from a defence perspective to gather as much knowledge as possible. The Ministry of Defence already works regularly with certain knowledge institutes, such as the TO2 institutes, TNO, NLR and MARIN. In the present circumstances, however, the Ministry will need to broaden its focus to include more collaboration partners, such as universities (of applied sciences) or institutes falling under the auspices of the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Dutch Research Council (NWO). It is therefore laudable that the Ministry has affiliated with the ELSA Lab. ELSA Labs (Ethical, Legal, and Social Aspects) are concerned with sustaining strategic and innovative competitiveness in relation to artificial intelligence, whilst respecting ethical, legal and social values. The ELSA Lab Defence, for example, carries out research on Early Warning Systems, involving analysing text and images in order to counter disinformation. A lot of research is currently also being carried out at civil knowledge institutes in areas which impinge on defence themes, such as open source intelligence and strategic

100. Adviesbureau Berenschot (2024). Page 11 of the report makes clear which companies are being referred to: "They are companies, suppliers and knowledge institutes which are engaged in the design, development, manufacture and maintenance of defence equipment (Navy, Army, Air Force and Marechaussee) and products aimed at the public security market (e.g. police, Europol, the General Intelligence and Security Service (AIVD) and relevant public investigation and enforcement agencies), including cyber."
101. European Commission (2024c).
102. Ministerie van Defensie (2024b).

autonomy of the digital stack, also referred to as digital ecosystems.[103,104] Insights gained from this research are a valuable supplement to the Ministry of Defence research on these themes. It is therefore important that knowledge is shared between the civil and military domains. It is encouraging that the Ministry is working on this, for example through the NWO-funded DILEMA programme.[105]

Universities (including universities of applied sciences) are able to provide knowledge that is of high value for defence purposes. If the Ministry of Defence invests in them, the defence industry could benefit; the investments would enable more relevant knowledge to be developed and more specialists to be trained. By increasing the budget, the Ministry is already taking a broader view than in the past. The Ministry has for example signed up to knowledge initiatives such as the National Research Agenda (NWA) and the (now closed) National Growth Fund (NGF). These initiatives offer university researchers opportunities to increase their research funding.

More opportunities are arising for universities in the field of defence research and/or dual-use applications.[106,107] A discussion is for example currently ongoing at EU level on funding dual-use research.[108] To date, defence research funding has fallen under the EDF. The Horizon Europe programme permitted only civil research; funding for dual-use research was only permitted if the research focused exclusively on a civil application. The European Commission is currently investigating how dual-use could be embedded in future research.[109,110] Increasing the EDF funding could in time reduce the funding for the successor to the Horizon Europe programme. Universities need to become aware of these shifts, for example by thinking about changes that may be needed in the organisation to perform dual-use research. This also applies in a broader sense for knowledge development and innovation that is relevant for defence themes that are less military in nature, such as knowledge about the whole-of-society approach or logistics.

At present, universities each have their own individual attitude towards defence-related research and innovation. It is important that these institutions think about how they wish to relate to the changing world and the societal urgency of defence and security. This has two practical implications. The increase in hybrid threats means conflict is no longer

103. Okano-Heijmans (2023).
104. Sheikh (2022).
105. DILEMA stands for Designing International Law and Ethics into Military Artificial Intelligence.
106. Rathenau Instituut (2019).
107. AWTI applies the same definition of dual-use here as the European Commission in its White Paper (2024b). Dual-use items' means items, including software and technology, which can be used for both civil and military purposes.
108. European Commission (2024b).
109. Hoven (2024a).
110. Hoven (2024b).

exclusively a matter for the Ministry of Defence. The whole-of-society approach referred to earlier is seen as a means of making society more resilient. Hybrid threats (such as access to energy resources or disinformation) mean it is not only knowledge about new weapons systems that is relevant for the Ministry of Defence, but also knowledge about logistics, digital and other infrastructure, cybersecurity, behaviour, energy, cultural studies and media and communication studies. AWTI has previously recommended that universities should focus more on the needs and expectations of society.[111] In turn, what society expects from these institutions will change with the growing threats and the urgency of protecting our country and our society. Knowledge institutes have themselves become a part of the conflict; as the owners of strategically valuable knowledge, they could for example become targets of espionage.[112] As public institutions, they are also places where different beliefs, opinions and ideologies can come into conflict with each other.

Our interviews showed that the willingness to participate in defence research varies widely between universities, and in some cases is completely absent.[113] University staff enjoy academic freedom and must be free to decide for themselves which type of research they perform. At the same time, it is important to define adequate parameters for those researchers who do (agree to) perform defence research. At present, universities have little experience with defence research and often lack the frameworks needed to assess the associated ethical issues, for example.[114] University administrators sometimes appear to have little awareness of the activities of individual researchers who are involved in defence research.

The Ministry of Defence and universities have different cultures. For example, universities prioritise international cooperation, academic freedom and openness,[115] whereas the Ministry often only wishes to work with researchers from NATO partner countries, or is unwilling to publish the results of research. Here again, judgements need to be made. The lack of clarity about which type of defence research is desirable and/or is already taking place leads to tensions between the differing values of universities and the defence ministry. This dilemma can be compared to the debate about knowledge security, on which AWTI has previously published an advisory report.[116] Universities have a great deal of knowledge that could be used by the Ministry of Defence. At the same

111. AWTI (2019).
112. AWTI (2022).
113. See e.g. Thompson (2023).
114. Universities of the Netherlands is working on a joint declaration and guide on collaboration with third parties.
115. Section 1.6 of the Dutch Higher Education and Research Act stipulates that universities (including universities of applied sciences) must respect academic freedom.
116. AWTI (2022).

time, universities do not meet the same conditions as organisations such as TNO Defence, Safety and Security.[117] The developments taking place around knowledge security are however already prompting institutions to move towards increased compartmentalisation. This offers opportunities to carry out (more) defence research. To achieve this, universities wishing to perform such research will need to make clear what financial resources they need.

117. Employees of TNO Defence, Safety and Security are for example subject to vetting and their work spaces are not accessible to the public.

3

Four recommendations for mobilising the entire knowledge ecosystem

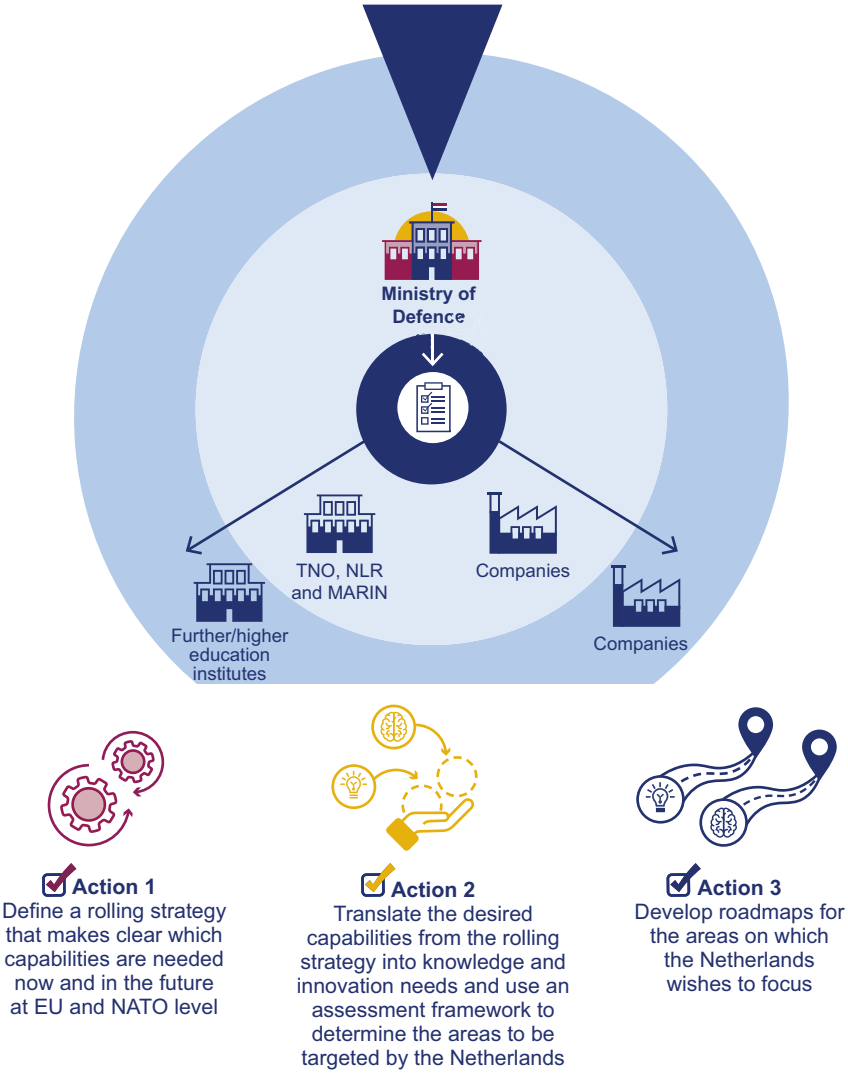
In the last chapter, AWTI set out the main arguments for extra measures to mobilise the entire knowledge ecosystem more effectively. This mobilisation will help make the Netherlands more secure and strengthen NATO, and will contribute to greater European strategic autonomy. In this chapter we make recommendations with specific actions to put the overarching advice 'mobilise the entire knowledge ecosystem' into practice.

The Council advises the Ministry of Defence to offer focus and maintain control (Recommendation 1) and to create scope for bottom-up initiatives across the knowledge ecosystem and within the defence organisation (Recommendation 2). The Council advises the Ministry of Economic Affairs, in liaison with the Ministry of Defence, to support defence-related companies through appropriate innovation policy (Recommendation 3). Finally, AWTI calls on further and higher education institutes and the Ministry of Defence to make reciprocal agreements aimed at forging long-term cooperation (Recommendation 4).

3.1 Recommendation 1: Focus resolutely and systematically on a small number of areas in which the Netherlands can make a difference (within NATO/EU)

The Dutch knowledge ecosystem can supply high-grade knowledge and innovations which contribute to strengthening NATO in general and Dutch defence in particular. It can also contribute to (greater) European strategic autonomy, an important goal given current geopolitical developments. This contribution will be greatest if the Netherlands focuses resolutely and systematically on a small number of areas. AWTI defines three actions to put this recommendation into practice (figure 3).

Figure 3. Recommendation 1: Focus resolutely and systematically on a small number of areas in which the Netherlands can make a difference (within NATO/EU)



Action 1. Define a rolling strategy that makes clear which capabilities within EU and NATO context are needed now and in the future

Geopolitical shifts are putting pressure on the EU to act as a united front. Capabilities of partner countries need to be coordinated at NATO and EU level. Where possible, the Netherlands needs to strengthen the NATO and European defence by realising

capabilities in those areas where it can make a difference. In addition to collaboration with frequent partner countries, good coordination will also require Dutch collaborations with other countries which are a good 'substantive' match in a particular case. Ensuring the success of these collaborations will require not only technological innovation, but also innovation at the level of processes, concepts and attitudes.[118] Attention will also need to be given when developing capabilities to development cooperation and diplomacy.

The required capabilities at NATO and EU level will then need to be mapped onto the Dutch context. The Ministry of Defence uses a multi-year process for this in order to develop the required capabilities based on its view of future threats and conflicts. It is important that this multi-year process allows scope to incorporate new developments. A rolling strategy which takes account of the changing world is appropriate here. The envisaged capabilities which this rolling strategy needs to produce, for example in the form of an annual research and innovation agenda, must be sufficiently broad to meet the challenge of hybrid threats and other technological and non-technological challenges.

Action 2. Translate the desired capabilities from the rolling strategy into knowledge and innovation needs and use an assessment framework to determine the areas to be targeted by the Netherlands

The capabilities then need to be translated by the Ministry of Defence into the relevant knowledge and innovation requirements. The Netherlands will only be able to generate a part of the knowledge or innovation needed to meet these requirements, because the Netherlands does not have the necessary industrial activity or knowledge available to meet all challenges, and is too small to take on everything. It is therefore important to select a limited number of challenges for knowledge development, under responsibility of the Ministry of Defence, for which the Netherlands is well equipped in terms of knowledge, innovative strength and industrial activity. The Netherlands can take an international lead on these challenges and make the difference. This will require that the Ministry of Defence also possesses substantive technological knowledge regarding the required capabilities and the knowledge and innovation requirements.

When selecting these challenges, the Council recommends using an assessment framework to make an objectifiable, considered selection of the knowledge and innovation requirements or areas on which the Netherlands wishes to focus. Key aspects of this assessment framework are:

118. Watts (2024).

- Is the required knowledge (largely) present in the Netherlands and does it give the Netherlands a prominent place in the world or in Europe?
- Are there relevant companies in the Netherlands and are they willing to invest?
- Does a market exist or can it be created, potentially with the help of the government? In practice, this is a matter of how well knowledge development and innovations align with the activities of the Dutch defence sector or the partner countries with which the Netherlands collaborates closely.
- Are there opportunities to 'link' with other innovations, sectors or developments? Does the knowledge or innovation area align with the priorities set in the NTS?[119] Does the activity align with the Dutch economic structure and Dutch society?

The Ministry of Defence recently took a first important step by identifying five priority areas for research and innovation.[120] These priority areas are broadly formulated, and it is important to link them to more specific defence-related knowledge and innovation requirements and the underlying capabilities. The Council advises the Ministry to make these links explicit where possible.

Action 3. Develop roadmaps for the areas on which the Netherlands wishes to focus

The next step, again under the responsibility of the Ministry of Defence, is to develop roadmaps for the selected knowledge and innovation requirements that are implemented systematically so as to build on the relevant knowledge and innovation ecosystems. The roadmaps can be developed by the appropriate knowledge institutes, companies and the Ministry of Defence, but responsibility for the development and implementation must lie with the Ministry. The Council recommends drawing on the experiences gained with earlier roadmaps, including the Maritime Knowledge Network (Kennisnetwerk Zee). When working up and implementing the roadmaps, it is important also to devote attention to fulfilling the 'broker function': linking potential users, innovative defence companies,TO2 institutes and further and higher education institutes so that they can complement and reinforce each other. Making a success of the roadmaps will require multi-year funding and support from the operational command structure. Procurement officers must also be aware of the duration of an innovative development. Top-down innovation must not be organised solely at a central level, but must involve end-users and procurement officers early in the process.

119. If a potential priority area for the Ministry of Defence is not included in the National Technology Strategy, there may of course be other persuasive reasons why the Ministry of Defence still opts for this priority area in the defence context.
120. Staatssecretaris van Defensie (2024).

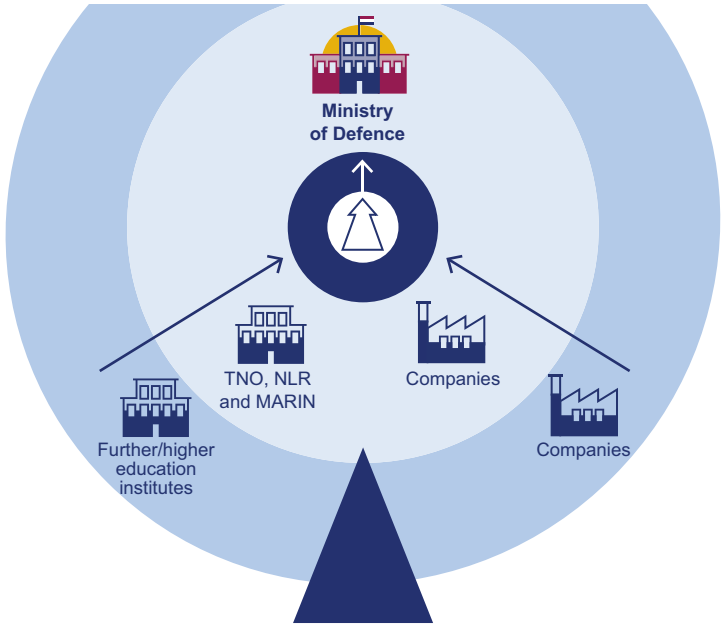
The defence organisation consists of different armed forces components, but some innovation and research assignments go beyond the boundaries between them. The Council recommends that the role of such overarching innovation be embedded and strengthened, so that these innovations are also picked up. Such overarching innovations are difficult to organise, but the roadmaps can play an important role here by effectively organising the embedding of governance for these specific innovations, for example by coordinating timelines, and ensuring an adequate budget.

3.2 Recommendation 2: Create scope for bottom-up initiatives across the entire knowledge ecosystem and the defence organisation

AWTI emphasises that steering research and innovation through multi-year programming must not take place at the expense of bottom-up initiatives from the armed forces, knowledge institutes and companies. Focusing on particular knowledge and innovation requirements or areas and implementing roadmaps with stakeholders will help give steering and direction to the knowledge ecosystem, but the (new) priority areas of the future will also have to emerge from a broad knowledge base. Steering is then less important and more reliance can be placed on research and innovative solutions that come from the armed forces, knowledge institutes and companies. The relevance of a knowledge area is after all subject to change due to technological and non-technological developments such as geopolitical shifts and new kinds of threats. Bottom-up initiatives from the armed forces, knowledge institutes and companies therefore warrant continued attention, otherwise there is a danger of missing out on technologies and applications which cannot be foreseen at the present time.

It is also important that the Netherlands is able to attract the knowledge and innovation needed for the development of the required defence capabilities. This implies maintaining sufficient knowledge absorption capacity in the Dutch ecosystem for defence-related research and innovation. Some of that knowledge absorption capacity lies within the Ministry of Defence, and some with knowledge institutes. The analysis in section 2.2 showed among other things that the knowledge absorption capacity at the Ministry is at a critical level. AWTI defines two actions to put this recommendation into practice (figure 4).

Figure 4. Recommendation 2: Create scope for bottom-up initiatives across the entire knowledge ecosystem and the defence organisation



Action 1
Organise and strengthen the scouting of fundamental scientific research and of civil developments with defence potential

Action 2
Embed innovation across the entire defence organisation to boost absorption capacity

Action 1. Organise and strengthen the scouting of fundamental scientific research and of civil developments with defence potential

Secondary vocational colleges and universities, the Netherlands Defence Academy and innovative companies possess high-grade knowledge on which the Ministry of Defence could draw more than at present. Insights gained from research at civil knowledge institutes are a valuable addition to the research already carried out by the Ministry itself.

However, the strength of universities in fundamental research could be made more suitable for the Ministry of Defence. The Council therefore recommends that the scouting function for fundamental research within the knowledge ecosystem be strengthened. An example of how this could be done is the American Office of Naval Research (ONR; see Box). The ONR does not seek to steer research, but provides grant funding for scientific and technological areas from which it expects potential military applications to ensue. It also has an intensive scouting capacity to help identify breakthroughs, which can then be transferred from the civil domain to secure defence labs for development as military applications. The ONR thus creates a solid link with fundamental research so as to be able to make optimum use of it.

Office of Naval Research

The Office of Naval Research (ONR) is an American organisation tasked with discovering, developing and delivering new technology and capability for the Navy and Marine Corps. The ONR administers and funds basic and applied research and the development of advanced technology by means of grants and contracts with a series of partners in the academic world, industry and government in the US and the rest of the world.

The ONR Global International Science Program employs technically trained scientists and engineers to increase the awareness of the Navy regarding international science and technology. The technical staff (science directors, generally holding doctorates and employed in government, the academic world or industry) have bases throughout the world to scout technologies for the ONR and the Naval Research Enterprise (NRE). They spend between two and four years on a tour of international knowledge institutes. During this tour they seek out groundbreaking science and technology, assess innovation on themes that are relevant for the Navy, make global technical assessments, follow trends in science and technology, and track technological development in specific geographical regions. The science directors recommend innovative researchers for grants. They focus on identifying disruptive technology and science, initiating and administering grants, linking up with international researchers and expanding the network of researchers and knowledge institutes.

As well as the science directors, there are science advisers, civil scientists who have been selected to participate in career development programmes lasting from one to three years. Science advisers act as senior liaison between an operational unit and scientific and technological organisations in the government, the academic world and industry. An interesting point here is that the programme serves as a kind of scouting

project for scientific talent who are willing to work for the American defence organisation.

The defence-related TO2 institutes, such as TNO, NLR and MARIN, currently fulfil this scouting function for fundamental research for the Ministry of Defence. TNO was for example responsible for the technology exploration which formed the basis for the SKIA 2020-2025. AWTI believes that this collaboration will play a key role in identifying future priority areas, though it is important that the Ministry of Defence has sufficient absorption capacity to properly assess the value of information provided by TO2 researchers. In the existing collaboration between the Ministry and TO2 institutes, some links could be embedded via the NATO Science and Technology Organization, whose task is to meet the science and technology needs of the NATO alliance and its partner countries.[121]

As well as targeting fundamental scientific insights, scouting also has to focus on relevant innovations in the civil domain which are then transferred to the military domain (short-cyclic innovation). This task currently rests with organisations such as Brainport, acting as a DIANA-hub, and the participation by the Ministry of Defence in Brainport Innovation & Technology Security (BITS), as well as the scouting role fulfilled by the MINDbases in Eindhoven, Enschede and Rotterdam. This scouting function could also be strengthened and developed further. AWTI regards the attention the Ministry of Defence is now devoting to other regional networks, including collaboration with regional development agencies, as a positive development.

In addition to these scouting functions for fundamental research and relevant innovations in the civil domain, consideration can be given from a whole-of-society approach to knowledge developed by ‘unusual suspects’ and how that knowledge could be used more effectively. Examples include knowledge held by civil-society organisations concerned with issues that impinge on security matters, such as the example of circular energy referred to earlier (section 1.2). Technological developments are also taking place at civil-society organisations which lead to the development of new research methods, such as the analysis of open source intelligence in the investigative journalism network Bellingcat.

Action 2. Embed innovation across the entire defence organisation to boost absorption capacity

After the scouting of developments, the Ministry of Defence must have sufficient absorption capacity to absorb knowledge, convert it into innovation and scale it up within the organisation. This absorption capacity needs to be increased by creating space for

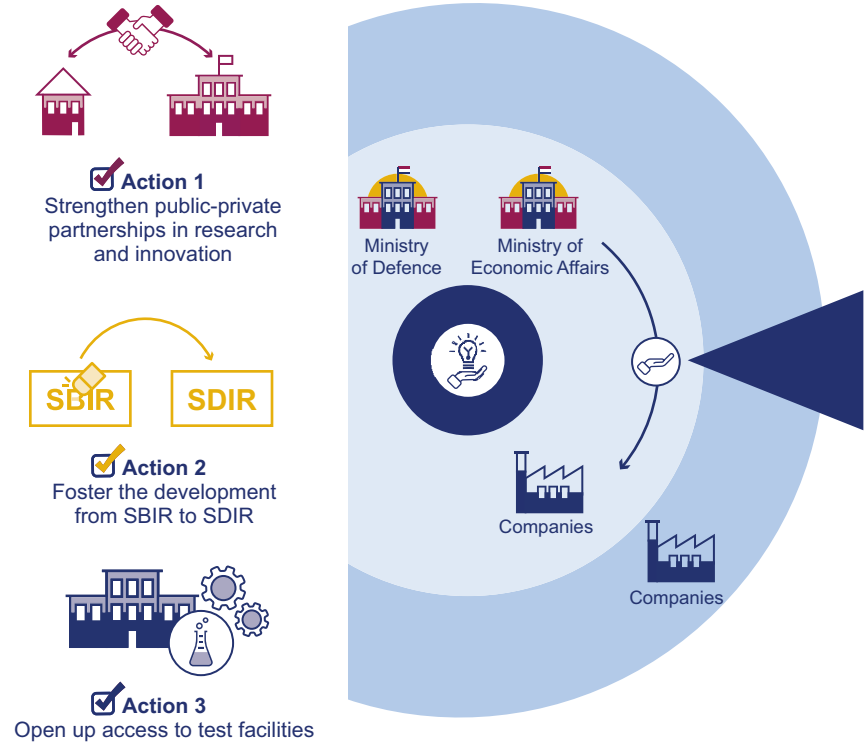
121. See https://www.sto.nato.int/Pages/default.aspx

bottom-up innovation within the organisation. This means that colleagues from the operational commands need to be involved from the development of a pilot; this will increase the effectiveness of and support for innovative solutions within the operational commands that ultimately have to work with the solutions. In turn, the operational commands within the defence organisation must be helped to free up time to participate in pilots, with knowledge of the pilot and with project leaders who supervise the pilot to ensure that the innovations chosen and proven by operational commands are upscaled and implemented. The Ministry of Defence is a hierarchical organisation, which means this can be challenging, but respecting the wishes of the operational commands is extremely important. It is therefore a highly positive development that staff at operational level are being involved, for example in the pilot phase of projects at MINDbases. To avoid disappointments, staff at all hierarchical levels need to be involved, including staff of the procurement organisation COMMIT (see also Action 2 under Recommendation 3). To achieve this, we advise the Ministry to abandon the risk-avoidance culture and to propagate the importance of innovation within the entire defence organisation.

3.3 Recommendation 3: Develop an appropriate innovation policy for the defence sector

A healthy defence sector which contributes to European strategic autonomy is the primary goal. To achieve this, the Dutch government will need to work with other European Member States for mutual reinforcement and joint development of the required defence capabilities. This offers ample opportunities for the Dutch defence industry, but more innovative strength is needed in order to put the industry in a better position to exploit those opportunities. To supplement the general innovation policy, the Ministry of Economic Affairs could partner with the Ministry of Defence to develop a number of specific instruments to further bolster the innovative strength. AWTI defines three actions to achieve this (figure 5).

Figure 5. Recommendation 3: Develop an appropriate innovation policy for the defence sector



Action 1. Strengthen public-private partnerships in research and innovation

To provide better support for innovative companies in the defence industry, a number of changes need to be made in the approach to public-private partnerships in research and innovation. The government can ensure more effective public-private partnerships in research and innovation by adapting the conditions for participation in them, to make it easier and more attractive for smaller companies and start-ups to participate. Those conditions relate to things such as co-funding requirements (lowering the percentage contribution required from smaller companies and start-ups or allowing more in-kind contributions), reducing red tape or protecting intellectual property. The government can also actively seek out SMEs, support their innovative activities and refer them to suitable support instruments, for example through the use of innovation brokers. The Ministry of Economic Affairs already has experience with this. The government could also issue more calls aimed specifically at smaller and newer players, for example by introducing

extra incentives for knowledge institutes to increase their focus on research that is also relevant for smaller and new players. If the government funds specific private-public partnerships where the public participation is higher, more companies will feel drawn to participate. This could be done for innovation themes that are of high societal value, for example, but for which private co-funding is not automatically available.[122]

Action 2. Foster the development from SBIR (Strategic Business Innovation Research) to SDIR (Strategic Defence Innovation Research)

The Ministry of Defence procurement organisation (COMMIT) plays a key role in promoting the upscaling of innovations. By focusing on innovative procurement, COMMIT could supply the armed forces with advanced and innovative solutions more quickly. AWTI calls on the Ministry of Defence to continue the further development and rollout of the Strategic Defence Innovation Research (SDIR) approach in which the Ministry acts as a launching customer and works alongside the market to go through a structured process with clear agreements from initiation to actual upscaling. This approach meets the objections raised by the mainstream Small Business Innovation Research (SBIR) approach, where a regular procurement procedure still has to be followed at the end of the development process with no guarantee that the SBIR innovation can actually be purchased.[123]

Action 3. Open up access to test facilities

Companies, and especially SMEs and start-ups, must be able to use shared public research and test facilities at an affordable cost. This infrastructure can be too expensive for (small) companies, because they have to meet all the costs of commissioning, maintenance and depreciation, leading to high charges (generally higher than in other countries).[124] The government could provide better support for access to and use of facilities, for example through a separate programme or fund offering financial support to companies to use research and test facilities, as happens in India.[125] An alternative would be for the government to expand the funding of public infrastructure so that managers of these facilities can not only invest in keeping them up-to-date but can also charge lower, competitive fees or allow free access for special programmes or challenges.[126] The

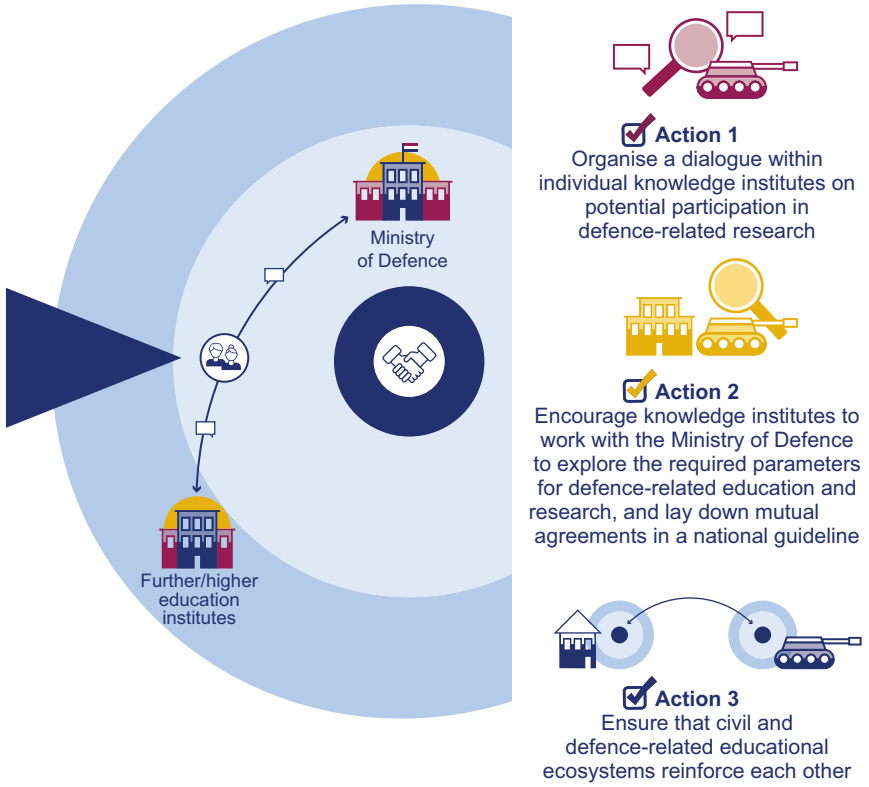
122. It is in fact uncertain to what extent extra public funding would lead to more private activities and contributions (more additionality), or would simply replace other contributions. No firm statements are available on this. See Dialogic (2021).
123. See https://innovatiegerichtinkopen.substack.com/p/verslag-marktochtend-innovatiegericht
124. Evaluatiecommissie TO2 (2021).
125. Ministry of Defence (2024).
126. Deltares, for example, organises ‘SME challenges' in which SMEs can apply for free access to facilities to test design concepts for innovations. And TNO has a fast track system to support SMEs, including with access to facilities.

Ministry of Defence should also speed up the processes for gaining access to civil facilities owned by the Ministry, such as hospitals, (unpaved) roads, landing strips, swimming pools, forests, etc.

3.4 Recommendation 4: Forge reciprocal agreements on sustainable collaboration with education and knowledge institutes

The Ministry of Defence knowledge ecosystem is broadening, and hybrid threats mean that, unlike in the past, new parties are finding themselves involved in conflict. Based on a whole-of-society approach, it is therefore logical to involve education and knowledge institutes more closely in the Ministry of Defence knowledge ecosystem. They do however have different expectations and work in a different way. For example, they are different from the TO2 institutes with which the Ministry currently collaborates frequently, and there are also differences between education and knowledge institutes. Achieving sustained cooperation in research and education will require dialogue and reciprocal agreements. The following actions are accordingly aimed at further and higher education institutes, the Ministry of Defence and the Ministry of Education, Culture and Science (figure 6).

Figure 6. Recommendation 4: Forge reciprocal agreements on sustainable collaboration with education and knowledge institutes



Action 1. Organise a dialogue within individual knowledge institutes on potential participation in defence-related research

To participate in a dialogue with the Ministry of Defence, education and knowledge institutes must organise internal conversations about the purpose, nature and method of collaboration with the Ministry. Knowledge institutes must be willing to look more openly at which mainstream scientific research could also be of military interest, for example AI, sensing, integrated circuit design, mechatronics, or human-robot interaction; however, hybrid threats mean that knowledge areas referred to earlier with more societal interfaces, such as media and communication studies and language and cultural studies, are also becoming more important. For many, looking at things in this way requires a mental and cultural change; this will require knowledge institutes as employers to engage in a good ethical debate with their staff and students. There is a reticence among some

researchers to be involved in defence research. Objections in principle must of course be respected and academic freedom must be safeguarded, but it is undesirable if such reticence stems from ignorance. Dialogue increases awareness and prevents opportunities offered by scientific research for defence from being lost due to preconceptions.

Action 2. Encourage knowledge institutes to work with the Ministry of Defence to explore the required parameters for defence-related education and research, and lay down mutual agreements in a national guideline

AWTI advises universities (including universities of applied sciences), secondary vocational education (MBO) colleges and research institutes to engage in dialogue with the Ministry of Defence to formulate a national guideline which provides a framework with parameters covering the ways in which the Ministry will (be able to) work with these institutes. AWTI explicitly includes secondary vocational education (MBO) here, because valuable lessons can be learned from practical training around the development and implementation of innovations in professional practice. The Ministry of Defence is used to imposing requirements on collaboration partners in the context of security and accessibility, for example the General Security Requirements for Defence Contracts (ABDO).[127] Higher education institutes are also used to imposing requirements on their collaboration partners, for example with regard to open science, academic freedom and scientific integrity. There is thus a tension here. The Ministry of Education, Culture and Science could also play a role in bringing these parties closer together. Based on the national guideline, directors of knowledge institutes could determine the degree to which their knowledge institute contributes to defence research. Among other things, the guideline addresses ethical considerations, secrecy and confidentiality, and thus creates the framework within which work can take place.[128] The guideline is being developed in order to build up long-term collaboration and needs to be based on reciprocity. AWTI sees the development of this guideline as part of a broader development around the democratisation of education and knowledge institutes. We therefore recommend setting up a commission consisting not just of directors of knowledge institutes, but also their staff and students as well as Defence staff. Supported by an independent chair, this commission would be tasked with drawing up a national guideline.

AWTI also proposes that defence ‘challenges’ be set up where researchers and students from universities, universities of applied sciences and secondary vocational colleges work

127. The ABDO provides a framework of standards for companies carrying out assignments for the Ministry of Defence.
128. AWTI has previously called for a comparable approach with regard to knowledge-intensive start-ups, in its advisory report *Beter van start* (‘A better start’). See also AWTI (2020a).

together in multidisciplinary teams on specific Ministry of Defence topics. The challenges focus on concrete knowledge and innovation questions from the Ministry which must lead to new insights and results in the relatively short term. Several knowledge institutes can work together on a particular challenge, possibly in co-creation with the Ministry itself and with industry. Eindhoven Engine is an example of how researchers, students, companies and other organisations can come together to develop knowledge and innovation for specific questions and challenges. Initiatives such as Eindhoven Engine are aimed at the civil domain, but a similar approach could also be applied for dual-use or military topics. Such an approach could align fundamental and applied research more closely with the speed of developments in the defence field. The commonly used approach based on four-year doctoral programmes is inadequate to meet many of the challenges. The length of a doctoral programme does not align with the shorter-term needs of the Ministry of Defence, nor with the speed of technological developments that are relevant for the required defence capabilities. Moreover, the objectives are misaligned: the goal of a doctoral programme is to demonstrate competence and publish scientific articles, whereas the goal for the Ministry of Defence is to obtain new, applicable knowledge and solutions for the required capabilities.[129]

Action 3. Ensure that civil and defence-related educational ecosystems reinforce each other

In addition to research, secondary vocational and higher education institutes have an important task in training people in defence-related disciplines. To prevent a shortage of manpower becoming a bottleneck, the Ministry of Defence needs to attract people with expertise. The Ministry will attract some people with specific knowledge around interesting developments that have been scouted, but manpower is needed across the whole spectrum in order to facilitate defence innovation. This means not just technicians, experts in technology development and ICT experts specialising in cybersecurity, but also innovation scientists or people with a background in relevant social sciences and humanities such as psychology, linguistics or ethics. With this in mind, it is important that the Ministry seeks closer links with schools and training programmes. Talent recruitment must be developed by setting up joint education programmes and organising internships. A physical campus can also be established, such as the Safety & Security Campus in Oirschot, to bring together education, industry and the Ministry of Defence on or near a military base. Links like these can first and foremost contribute to increasing societal

129. A two-year EngD programme, which also has different objectives from a PhD, could offer better alignment.

awareness of the importance of defence, as well as strengthening knowledge-sharing between the defence and broader knowledge ecosystems.

Bijlagen

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In the final phase of preparing this advisory report, the draft report was submitted to two external reviewers:

- Béatrice de Graaf, Faculty Professor of History of International Affairs and World Governance at Utrecht University; and
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The reviewers reflected on the consistency of the draft report. Where any gaps were identified, the reviewers' comments were incorporated under the responsibility of the Council.

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