Whitepaper

Why High-tech matters for Defence transformation



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Government Response to the rising challenge

The war in Ukraine, growing geopolitical competition and strain on international supply chains have exposed the limits of Europe's defence-industrial capacity, which is not scaling up fast enough to meet demand. Meanwhile, technological change is reshaping warfare and shortening the time available to turn new knowledge into operational capability. The Dutch government's approach to the defence industry has shifted markedly in response to this deteriorating security environment. Currently there is a need for valorisation of our knowledge position, in order to ramp up large-scale production and to form targeted innovation policy for the Dutch high-tech industry.

The current Defence Strategy for Industry and Innovation 2025–2029 (D-SII) starts from the premise that the Netherlands is neither at war nor fully at peace. The strategy is broad, linking knowledge development, innovation, procurement, industrial production and international cooperation into a single, action-oriented strategy.

The government has set three linked priorities: strengthening the Dutch Defence Technological and Industrial Base (NLDTIB); accelerating innovation; and deepening cooperation between the armed forces, industry, research organisations, financiers and international partners, summarised as *strong, smart* and *together*.

This marks a shift in how government organises the relationship between operational needs, innovation and industrial capacity. Analyses suggest that thousands of Dutch companies possess relevant manufacturing competencies but have limited engagement with defence markets. Mobilising these companies may prove as important as scaling existing defence suppliers[1]. The central challenge now is translating this strategic direction into predictable demand, faster decision-making and concrete orders, without which companies cannot justify the investment in facilities, people, stock and supply chains needed to scale up production.

Europe's defence challenge is therefore not only to innovate faster, but also to produce, replenish and adapt at sufficient scale. Technological superiority creates military advantage only when systems can be manufactured in sufficient quantities, sustained through robust supply chains and continuously adapted to changing operational needs. For the Netherlands, this means that defence transformation requires both innovation capacity and industrial capacity.

However, connecting these two worlds requires more than matching technologies to military applications. Decisions about where the Netherlands should invest, need to consider several perspectives simultaneously: how geopolitical dependencies and international supply chains affect security of supply; where national and European industrial capabilities provide strategic leverage; how procurement and innovation policy can stimulate private investment; and which technology areas can realistically develop into sustainable ecosystems. The challenge is therefore not simply to identify promising technologies, but to connect strategic priorities to industrial capabilities, research agendas and ultimately concrete innovation programmes.

In essence, how can the two worlds of defence and high-tech industries find each other and merge in order to solve the issues of innovation scaling and domestic manufacturing industry?

1 Mobilizing the Dutch defense industry: An analysis of Dutch defense spending and the potential opportunity for the domestic manufacturing industry



Figure 1. Overlapping interest and potential for capability building between Dutch HTI and the Dutch Defence domain.

Scaling of Dutch Industry

Credible military capability depends on the capacity to produce, maintain, replenish and improve its systems continuously, in peacetime, during rising tension, and in conflict. The current NLDTIB, comprising over 1,000 companies and research organisations, is a solid base: turnover rose from €4.7 billion in 2021 to €7.7 billion in 2023, with roughly 11% reinvested in R&D and 43% from exports. Even so, the D-SII concludes that further scaling is needed across the whole trajectory from research to production and maintenance.

Recent conflicts underline that industrial capacity is itself a strategic capability. A technologically superior system has limited value if it cannot be produced in sufficient numbers, replenished after losses, repaired and adapted at the pace required by operations. Scaling is therefore not a downstream activity that follows innovation: production capacity, supply-chain resilience and maintainability need to be considered from the outset.

For policymakers, scaling should not be understood simply as constructing additional production lines. The future defence-industrial base must meet several connected requirements.

1. **It must respond to continuously changing operational demand**
   Operational requirements shift constantly as battlefield conditions, adversary tactics and technology evolve, especially in areas like uncrewed systems, electronic warfare and AI. This demands modular designs, reconfigurable production and a continuous feedback loop between operational practice and industry, with requirements specified loosely enough to allow adaptation.

2. **It must support continuous innovation**
   Technological advantage is temporary, so the goal is a faster learning cycle than adversaries. The D-SII calls for closer links between knowledge development, experimentation and procurement, more room for "intelligent failure," and programmes, supported by the new SDIR (Strategic Defence Innovation Research) framework, that consider production and maintenance from the outset rather than stopping at a prototype.

3. **It must scale between peacetime, crisis and conflict**
   Production needs can jump sharply in a crisis, so industry needs more than spare capacity, it needs ready access to staff, components, suppliers and finance throughout the supply chain. Strategic stocks, second-source suppliers and flexible manufacturing can shorten ramp-up time, and the same flexibility is needed to move quickly from experimental solutions to large-scale production of the best ones.

4. **It must move from decades-long development cycles to short-cycle innovation**
   While platforms like ships and aircraft last decades, their sensors, software and other subsystems change far faster. Open architectures and modular, standardised interfaces should let these be upgraded independently, replacing today's sequential development-acquisition-maintenance model with an ongoing cycle of operational feedback, experimentation and upgrades.

5. **It must remain economically viable when demand decreases**.
   Companies that invest in extra capacity risk being left exposed if tensions ease, the economic risk of an "outbreak of peace." Given the defence market's small customer base and uncertain demand, the government has earmarked €1.1 billion and a financing action plan to help make scaling commercially viable, resting on three conditions:

   - *Long-term government commitment:* Predictable multi-year roadmaps, framework agreements and, where strategically justified, minimum purchase commitments or co-investment give companies the confidence to invest in scale.

   - *Dual-use markets:* Civilian demand can sustain production and engineering capacity between military orders and drive down costs, though military use often requires separate validation, certification and adaptation.

   - *Access to export markets:* The domestic market is too small to sustain the NLDTIB alone, so exports, European coordination and pooled procurement are essential, within the bounds of arms-export control, to secure the Netherlands a strategic position in European and NATO value chains rather than full self-sufficiency.

Smarter, stronger, together

Translating these goals into action is a significant task. The war in Ukraine has challenged many long-held practices, demonstrating that in times of crisis, new solutions can indeed be developed, tested and deployed more rapidly than previously thought possible. Technologies that once took years to move from concept to full deployment are now progressing in months or even weeks.

This shift is changing not only how defence capabilities are developed, but also who contributes to them. Innovations addressing critical areas come not only from traditional defence contractors, but also from non-traditional suppliers; start-ups, research organisations and high-tech companies. Together, they are becoming important drivers for transforming innovation for defence and resilience purposes.

Role of high-tech

High-tech industries have an important role to play and one of the valuable learnings of the sector, can be found in its way of approaching innovation. Companies have spent decades refining innovation processes that emphasise speed, experimentation and continuous improvement based on real user feedback. These approaches can help defence organisations shorten innovation cycles and accelerate the journey from idea and validation to operational capability.

An iterative way of working helps identify what works (and what does not) before large-scale investments are made. While defence environments require reliability and safety above all, there is value in creating protected spaces where new concepts can be tested and lessons can be learned rapidly.

High-tech companies often address a specific challenge by co-creation, leaning on the vast existing knowledge that lies within the various experts. A similar multidisciplinary collaboration approach, bringing together various experts can help defence organisations address increasingly interconnected technological and operational challenges. Defence can benefit from short-cycle innovations where high-tech industry again benefits of the unique opportunity to more quickly test new technologies in real world scenarios and learn from the experiences of defence. Which could result in better tested and faster developed technologies that could benefit a broader demand than just defence related.

The contribution of high-tech industry goes beyond technological innovation. Its manufacturing capabilities, supplier networks, systems engineering expertise and experience with industrialising complex products can also contribute to defence production capacity. The opportunity is therefore twofold: accelerate the development of new capabilities, while also mobilising existing industrial capabilities to manufacture, integrate, maintain and upgrade them at scale.

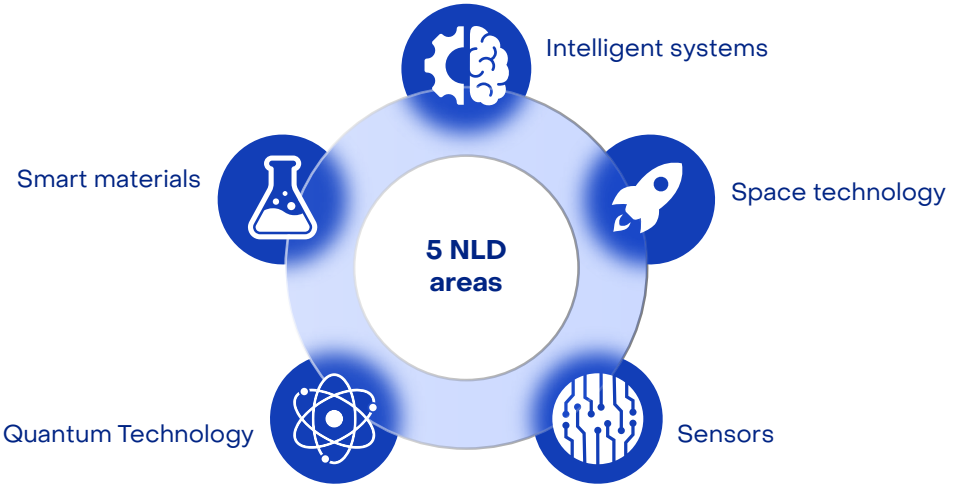


Figure 2. The 5 NLD focus areas as mentioned in the D-SII

Dual-use markets: a strategic opportunity

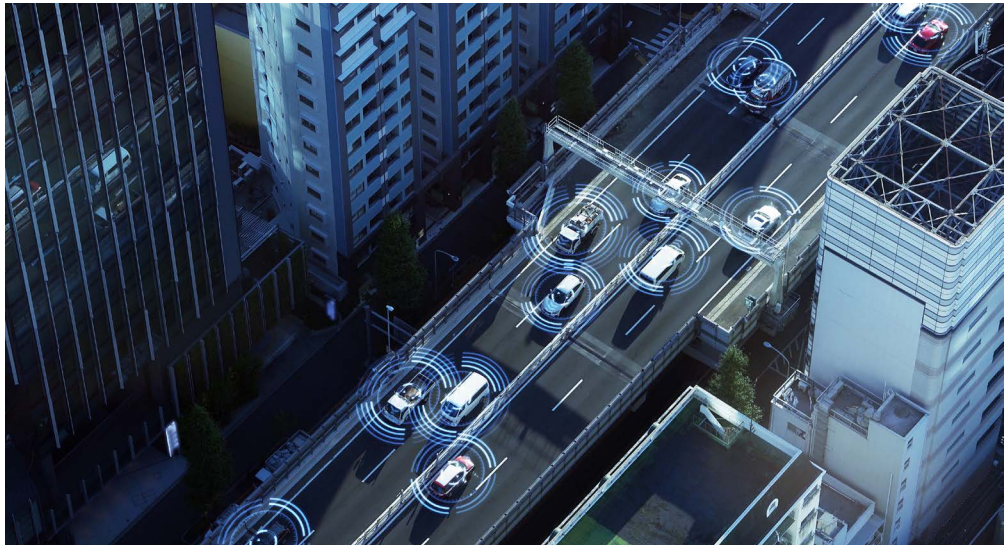
There is an opportunity to leverage civilian technological advances for defence purposes while also allowing defence-driven innovations to create civilian value. This dual-use approach offers several advantages. One of which is that it can significantly reduce development costs as, on one hand, multiple use cases are being developed and learned from. On the other hand, it also accelerates adoption and by creating these larger markets, scaling up is more feasible, recovering the investment in development.

Considering dual use applications, it also offers a more stable base for building a sustainable business, as the civilian and military demand balance each other through shifts in geopolitical volatility.

The following section provides examples of high tech innovations areas (as mentioned in the D-SII) how they add value across varied use cases. These are merely a few examples showcasing how high-tech industry and defense can support each other and boost innovation as dual-use.

Advanced sensors

4D imaging radars are commonly used in the automotive and robotics industries, applied for advanced vehicle safety and smart traffic control for example.



Modern defence also increasingly depends on understanding complex environments quickly and accurately. These types of advanced sensors (including radar, optical, acoustic and satellite-based technologies), can significantly enhance situational awareness in detection, monitoring and threat assessment capabilities.

Further combined with AI and machine learning, these technologies improve warning systems, infrastructure monitoring, target tracking as well as predictive analysis. The global market for 3D and 4D military radars is rapidly expanding to address the complex challenges.

From separate innovations to intelligent systems

Modern defence depends on the successful integration of diverse technologies, and the crux lies in connecting them effectively into coherent operational capabilities. This is an area where high-tech expertise can have significant impact. High-tech companies have extensive experience in managing complex digital ecosystems. As defence systems become increasingly interconnected, this integration capability becomes a strategic advantage.

Autonomous vehicles, drones and robotic systems are similarly becoming essential elements of modern defense operations. The convergence of civilian and military innovation in autonomous systems creates significant opportunities for collaboration. Events such as the European Land Robot Trial (ELROB) for field robotics and Unmanned Ground Vehicles (UGVs), give research organisations and companies a platform to test, adapt and promote their technologies in defense use cases.



Smart wearables

Technology alone is not enough. The effectiveness of any system ultimately depends on people. High-tech industries can contribute valuable expertise to improving human performance, resilience and well-being by sensors and smart wearables. Methods originally developed to monitor elite athletes' performance for instance can be adapted to support soldier readiness and operational effectiveness. Similarly, folded electronics and smart materials used for remote healthcare in sparsely populated areas may provide valuable insights for monitoring personnel in remote operational environments.

The Nordic region has shown how civilian high-tech innovations contribute. The smart sleep ring maker Oura (founded in Finland) was not originally set up to solve military challenges, yet their technologies are increasingly relevant in using wearables to track service member health, fatigue and for early illness detection.



Photo source: Oura Health Oy

Committing longer term

The objective is not merely to develop individual technologies one-off. It is to create the conditions under which companies can naturally create collaborations where knowledge is gained, shared and where innovation can continuously emerge.

By committing to long-term problem spaces and by building knowledge, organisations can attract a broader range of innovators to its ecosystem and enable sustained collaboration.

Another powerful approach is for governments and defence organisations to act as launching customers. Early demand creates opportunities for emerging companies to pivot and mature technologies while demonstrating their operational value.

Oura's shift 2019-2025 into the defense sector stems from a multi-year partnership with the U.S. Department of Defense (DoD). This relationship was able to expand significantly through long-term commitments (incl. local manufacturing) and secure government software integrations. Contracts have since shifted but it proves the power of longer-term commitment in the partnership.

As the Netherlands seeks to strengthen the defence capabilities, it is crucial to create an ecosystem capable of responding to the challenges. Many of the capabilities needed for future defence already exist within Europe's high-tech ecosystem and can be adapted more rapidly than developing entirely new solutions.

Defence transformation will require new ways of working as well as new partnerships between the public sector, research organisations and industry to develop the new capabilities needed to address the transformation challenges.

From ambition into action

As the world around us is changing, the defence transformation is clearly already underway, new partnerships and allyships are forming, where strong competitors from outside the Netherlands or the EU are forming a potential threat to European democracy as we know it. The Netherlands has the industry and knowledge base to compete and to form new industrial alliances. However the question is, whether we can bring together the capabilities of defence, industry and research quickly enough to meet the challenges ahead.

The fastest route to strengthening defence capacity is to bring the Netherlands' much broader high-tech innovation capabilities into the defence ecosystem. This is not only about bringing new technologies into defence, but also about combining innovation with manufacturing capacity, systems integration and resilient supply chains to turn technological potential into sustained military capability.

Building on existing industries, investing in control points and securing strategic autonomy. That means orchestrating innovation and creating the partnerships and innovation ecosystems that can deliver.

TNO Vector helps organisations navigate these challenges by bringing the right stakeholders together, creating shared objectives and translating complex ambitions into concrete, feasible actions. One example is the development of the Maritime Innovation Centre in Den Helder, where TNO Vector, in close collaboration with TNO Defence, Safety and Security, works with the Royal Netherlands Navy and stakeholders from the wider maritime ecosystem to develop a concept that connects defence challenges with companies, knowledge institutions and education.

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