Accelerating the future of aerospace

NLR Strategic plan 2026-2029

Royal NLR – Netherlands Aerospace Centre

Foreword

We are currently in a turbulent era of non-stop change and challenge. Although history tells us that periods like this always come and go in waves that vary from brief and intense to gradual and lengthy, we are seeing that the complexity of these developments is increasing.

The globalisation that began at the end of the twentieth century is playing a prominent role. Technological innovations are coming in quick succession, seemingly eliminating barriers to international exchanges of people, goods, capital and information. This worldwide interaction has yielded a great deal of prosperity for us, but has also made us more aware – in this age of rising geopolitical tensions – of the associated vulnerabilities and consequences for our society and for our economic security. We are now confronted with diverse interests on a variety of fronts: local versus global, shorter versus longer term, and individual versus collective interests.

This necessitates a clear vision and well-defined goals. NLR has set these out in this strategy plan, which has been drawn up with the utmost care. It sketches out the areas that NLR will be focusing on in the coming period. The entire organisation is committed to it, in order to help the government and the Dutch commercial sector make properly considered decisions and develop innovative solutions for questions that matter to society.

There is a price tag, naturally, whether that is measured in terms of maintaining our level of prosperity or wellbeing, or a healthy living environment for humans, animals and nature. The freedoms we have gained are not a given and they are under pressure. Although the course for the three strategic themes is largely unchanged with respect to the preceding strategy period, this time round we are concentrating explicitly on the areas where the themes converge. In doing so, we are emphasising a safe and resilient society more strongly, along with boosting the competitive capacity of our aerospace. However, the importance of sustainability remains undiminished.

The precise content of this strategy will be detailed further in the run-up to the 2026–2029 strategy period, in the form of one or more implementation agendas. Because of the amendment to the NLR control structure in mid-2025, it has been decided that this strategy plan should above all be a guide, giving the direction, so that the new board can make an effective contribution to the strategic developments.

Michel Peters, CEO of Royal NLR until 31 May 2025

The NLR board as of 1 June 2025.
From left to right:
CFO - Jan Lintsen
CEO - Tineke van der Veen
CTO - Martin Nagelsmit

Our mission is to improve the effectiveness, safety, sustainability and efficiency of aerospace

Summary

Knowledge and facilities ***Market and stakeholders***

Strategic themes and ambitions

DEVELOPING A VALORISATION STRATEGY

A NEW PROGRAMME FOR THE SPACE DOMAIN

ALIGNING THE LONG-TERM FACILITIES PLAN

AMBITION
AS A STRATEGIC PARTNER OF THE MINISTRY OF DEFENCE, NLR IS THE DRIVING FORCE ENSURING TIMELY AVAILABILITY OF THE REQUISITE CAPACITY, WORKING IN TANDEM WITH THE COMMERCIAL SECTOR

THEME
AEROSPACE FOR A SAFE AND SECURE SOCIETY

AMBITION
NLR ENHANCES THE FLEXIBILITY AND RESILIENCE OF DEFENCE OPERATIONS AND THE SECURITY OF SOCIETY BY DEVELOPING SUSTAINABLE SOLUTIONS

THEME
COMPETITIVE AEROSPACE

AMBITION
NLR RESOLVES ISSUES RAPIDLY AND FLEXIBLY

THEME
SUSTAINABLE AEROSPACE

AMBITION
NLR LINKS AVIATION WITH OTHER MODES OF TRANSPORT TO CREATE A FULLY SUSTAINABLE MOBILITY SYSTEM

KNOWLEDGE TRANSFER

COOPERATION FOR ACCUMULATING KNOWLEDGE

STRENGTHENING SECURITY

AN ECOSYSTEM FOR SUSTAINABLE MOBILITY

PEOPLE COME FIRST

EMPLOYER OF CHOICE

MODIFIED COMPETENCIES AND MINDSET

A SCALABLE ORGANISATION

BECOMING CLIMATE-NEUTRAL BY 2050

SUSTAINABLE DEVELOPMENT GOALS

People and organisation ***Corporate social responsibility***

Strategic themes and ambitions

Our mission as an applied research organisation is to improve the effectiveness, safety, sustainability and efficiency of aerospace. The way we see it is that we must accelerate high-impact innovations to build a safe, resilient and economically strong society in the Netherlands and Europe, climate-neutral aviation and sustainable and safe use of the space domain.

An extensive external analysis has led us to conclude that the course we set for the 2022–2025 strategy period using three long-term strategic themes – "Aerospace for a Safe and Secure Society", "Strengthening Competitive Aerospace" and "Sustainable Aerospace" – remains relevant.

The three themes have become yet more intertwined and will remain just as important after this strategy period. We will therefore basically continue to pursue our course during this strategy period, including the long-term ambitions we formulated for these themes such as supporting the Ministry of Defence in procurement, operational deployment and the implementation of its vision and strategy, and in making climate-neutral aviation possible by 2050, so that we can achieve a lasting impact.

The changing geopolitical situation and the increased interdependence of the themes means that we will concentrate explicitly during this strategy period on the areas where the themes converge, with more emphasis on a safe and resilient society, along with reinforcement of the competitive capacity of our aerospace. The importance of sustainability remains undiminished. We have formulated targeted ambitions for the areas where the themes come together.

- Because of the urgency for the Ministry of Defence, NLR works with the commercial sector to provide the necessary capacity and facilities in good time.
- NLR enhances the flexibility and resilience of Defence operations and the security of society by developing sustainable solutions that ensure strategic autonomy. Innovations in circularity and material recycling, as well as alternatives to fossil fuels, give the ministry option for becoming less dependent on critical resources.
- We resolve issues, rapidly and flexibly. Our stakeholders are focusing increasingly on short-cycle innovation. We will be supporting them in this with a fast innovation lane in addition to our existing structure for building up knowledge and developing technology. The first concrete result of the is the development of the Quick Response Drone Facility (QRDF) at NLR in Marknesse, working with the Ministry of Defence, centres of expertise and industry to let us get new drone functionalities operationally available within six weeks. We want to combine knowledge and domains to let us find disruptive solutions for the issues. We are for instance studying how we can utilise technology from the civilian domain to accelerate military developments and vice versa (dual use).
- NLR links aviation with other modes of transport to create a fully sustainable mobility system.

Knowledge and facilities

- We will develop a valorisation strategy to improve the process and the methods further for transferring our knowledge and technology. A clear link between our knowledge base, demand-driven NLR programmes and our contract research is essential for giving the research activities a more strategic direction in relation to the current and future needs of our stakeholders. That is why we are expanding the programme-based activities.
- A new programme is being set up that specifically targets the space domain because of its increased importance for Europe's strategic autonomy, the Ministry of Defence's focus on it and that domain's significant potential revenue for the Netherlands.
- During this strategy period, we will align our long-term plan for NLR and DNW facilities structurally at the national and European levels and collaborate where possible to accelerate the development of facilities.

Market and stakeholders

- As part of the valorisation strategy that is to be prouced, we are aiming to develop the Mobility and Infrastructure Test Centre (MITC) further as a campus near the NLR site in Flevoland, to offer knowledge-intensive and capital-intensive start-ups, scale-ups, SMEs and governmental organisations the opportunity to set up near our research infrastructure and expertise. The purpose of this campus and its location is to make NLR's knowledge more available, encourage valorisation and make our facilities more accessible. We are giving stakeholders an understanding of our knowledge and its development, as well as of technology. Access to private sources of finance is particularly important for start-ups and SMEs if we are to keep such companies in the Netherlands. NLR is investigating the possibilities for fulfilling a role for these companies during this strategy period.
- As regards research and the use and development of facilities, we will further intensify our collaboration with other applied research organisations (hereinafter "TO2"), our European sister organisations, universities and applied science and vocational colleges and the Netherlands Organisation for Scientific Research (hereinafter "NWO").
- NLR will continue to strengthen the Dutch defence sector's foundations and create strong partnerships that focus Defence Ministry and security needs.
- To link aviation with other modes of transport, we will reinforce cooperation with parties outside the aviation sector and help build a system-wide ecosystem for sustainable mobility, both nationally and internationally.

People and organisation

- People come first. Attention is paid continuously to welfare, inclusivity, social safety, diversity and leadership.
- In line with our aim of being an employer of choice, we focus not only on attracting, retaining and optimising the potential of our employees, but also on creating an inspirational and safe working environment where the staff can feel involved, valued, supported and challenged.
- The changing world and the direction that NLR is taking have an impact on staff, job roles and business operations. This demands other skills, networking and a different mindset.
- Our organisation is growing too and it is scalable. Strategic personnel planning for the newcomers and leavers over the next few years will be aligned with a long-term estimate of demand for the services we provide. This is how we will make sure that our turnover covers the workforce costs in the longer term.

Corporate social responsibility

- Corporate social responsibility is an essential component of the strategy for Royal NLR. Our goal is to be climate-neutral by 2030 in terms of our own emissions and by 2050 in terms of the emissions of the entire chain.
- We support the UN Sustainable Development Goals (SDGs). NLR has selected six SDGs and specific underlying objectives and has undertaken to make meaningful contributions.

Contents

1. Introduction 13
   - 1.1 REVIEW OF THE STRATEGY PERIOD 2022-2025 13
   - 1.2 LOOKING AHEAD TO THE STRATEGY PERIOD 2026–2029 & BEYOND 14
   - 1.3 READER'S GUIDE 15

2. Strategic position and situation 19
   - 2.1 INTERNAL ANALYSIS 19
   - 2.2 EXTERNAL ANALYSIS 24
   - 2.3 CONCLUSION 30

3. Strategic direction 33
   - 3.1 VISION 33
   - 3.2 AMBITIONS 34

4. Underlying principles for realisation 37
   - 4.1 PEOPLE AND ORGANISATION 37
   - 4.2 KNOWLEDGE AND VALORISATION 40
   - 4.3 RESEARCH INFRASTRUCTURE 42
   - 4.4 THE APPROACH TO THE MARKET AND THE STAKEHOLDERS 42
   - 4.5 FINANCES 45

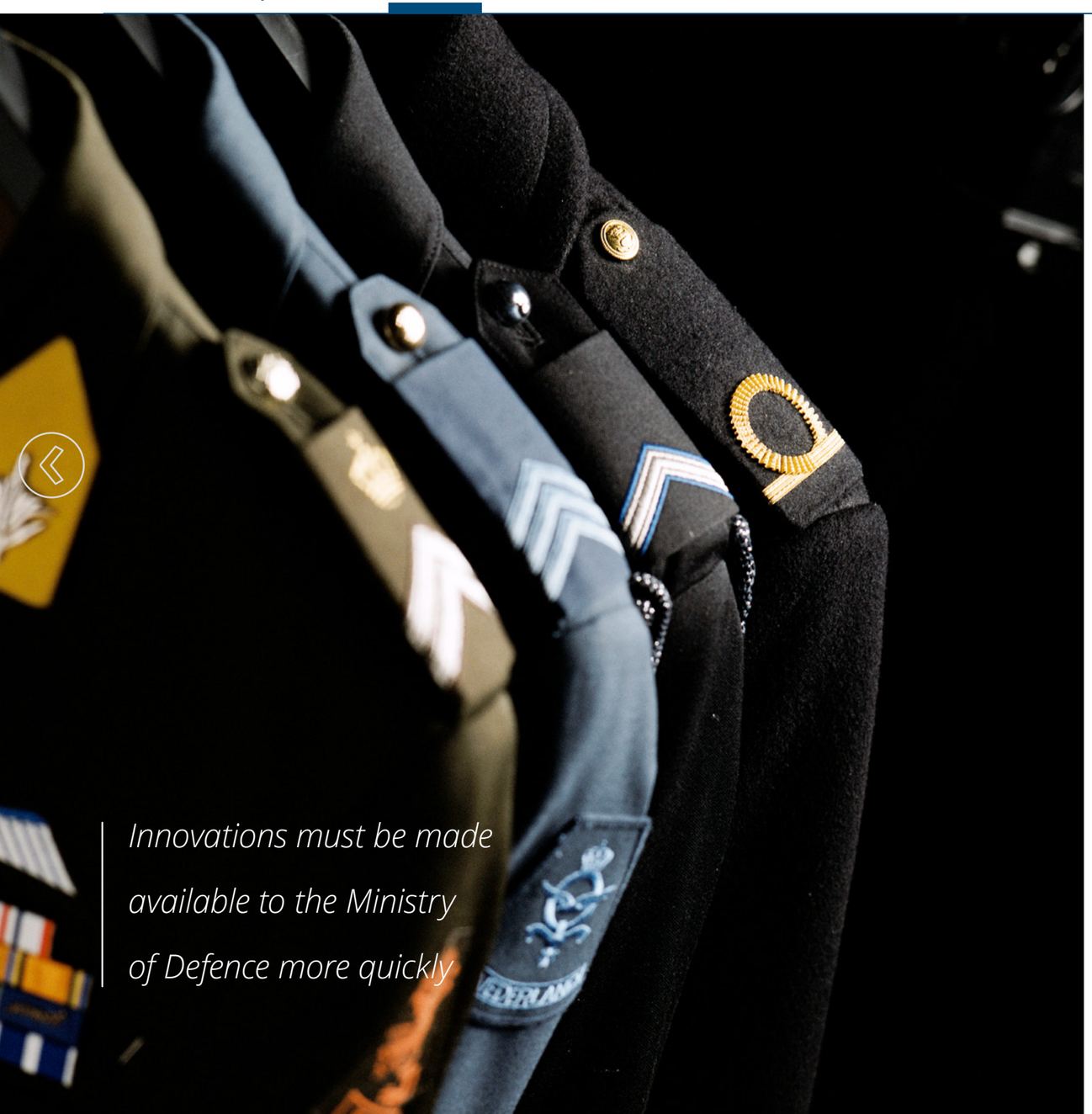
ABBREVIATIONS AND ACRONYMS 47

GLOSSARY 48

SOURCES 50

APPENDICES A OVERVIEW OF NLR PROGRAMMES 52

APPENDICES B OVERVIEW OF NLR FIELDS OF KNOWLEDGE AND FACILITY CLUSTERS 53



Innovations must be made available to the Ministry of Defence more quickly

1. Introduction

The risk of large-scale conflicts is rising worldwide due to increasing geopolitical tensions. According to the Netherlands Chief of Defence, we have quickly progressed from "warfare by choice" to "warfare by necessity", and it is essential for the security of the Netherlands that the Ministry of Defence and the defence industry are scaled up [1].

The ministry is clear on this: "The Netherlands and the Ministry of Defence need to [...] prepare for the worst and rapidly strengthen the armed forces and our resilience" [2]. On top of that, a hybrid situation has arisen that is between war and peace. This complex situation demands new solutions, different from previous ones, that are more multi-domain in nature and in which information dominance is essential. Innovations must therefore be made available more quickly to the Ministry of Defence, both to deter opponents and stay ahead of them. Niinistö believes that Europe's resilience – both military and civilian – must be strengthened [3]. Space is rapidly gaining attention as a defence domain due to its significance for security and society. This applies nationally [4,5], within NATO [6] and within the European Union (EU) [7]. It demands a joint effort by society as a whole, from government, the public at large, civil society organisations, the commercial sector, industry, centres of expertise and other pro-European players.

Innovations should be accelerators, not only in the military domain but also in the civilian sectors. The report on the competitiveness of the EU [8] drawn up by Draghi, former president of the European Central Bank (ECB), highlights the urgency of accelerating the reinforcement of Europe's economic power, innovation capacity and strategic autonomy. That report states that sustainability is not only an environmental and climate goal but must also become an economic and strategic aim. Innovations in sustainability and circular solutions can create new growth markets and benefit Europe's global competitive position. We now need more than ever to focus even more strongly on sustainability, as the targets defined in the Paris Climate Agreement seem to be slipping out of reach [9]. Heitor, the former Portuguese Minister for Science, Technology and Higher Education, also made various recommendations for the EU's next framework programme for research and innovation (2028–2034). Among other things, he recommends significantly increasing budgets and creating an ecosystem for research, development and innovation comprising interconnected and mutually supportive tools at the national and European levels, as well as embracing and exploiting the mutual technological dependence between the civilian and defence sectors [10].

The complex social challenges and changing geopolitical circumstances have consequences for policy choices made by the Dutch government and consequently for the priorities of the Dutch aerospace sector too. These changing circumstances demand a flexible organisation for the coming strategy period.

1.1 Review

Strategy period 2022-2025

The invasion of Ukraine by Russia early in 2022 led the Rutte IV cabinet to increase the defence budget by €5 billion per annum from 2023 onwards in order to meet the NATO standard of 2% of GDP being spent on defence [11]. This also raised the Ministry of Defence's budget for knowledge development, research and innovation [12]. For NLR, this meant inter alia a significant increase in programme funding from 2023 onwards for the "Safe society" research theme as part of the "Securiy" social theme. In addition,

NLR (together with Dutch companies in a European venture) was successful in winning research proposals in European Defence Fund (EDF) calls. In addition to the increase in the research budget for security, the budget for research into making aviation more sustainable also increased. It was announced on 14 April 2022 that €383 million had been made available from the National Growth Fund for the 'Aviation in Transition' proposal. Through to 2030, Aviation in Transition will be investing roughly €750 million (together with over sixty partners) in the Dutch aviation sector, thereby giving the economy a boost [13]. Moreover, NLR has participated successfully in European programmes such as Clean Aviation, SESAR and Horizon Europe.

To meet research needs and make good use of the correspondingly increased budgets, recruitment of new staff has been intensified significantly since mid-2022. The workforce has grown considerably. That kind of growth affects the organisation and its employees, impinging on everything from accommodation to knowledge management or sharing knowledge efficiently and effectively within the organisation. Professional knowledge of the fields, commitment, loyalty, flexibility and a solutions-oriented approach, plus the innovative capacity and perseverance of our employees, are the critical success factors for achieving our mission and objectives. The Evaluation and Monitoring Framework for Applied Research (hereinafter "EMTO") committee recommended in 2020 that a modern and inclusive personnel policy should be developed and that the organisation's growth should be steered in the right direction. As part of the follow-up to that, the onboarding process has been revised to improve the initial period for new staff and to help them feel at home within the organisation as quickly as possible. A buddy system has also been introduced, pairing new staff with experienced colleagues to familiarise them with the organisation; there is also a structural focus on inclusivity, social safety and diversity.

Progress was evaluated midway through the previous strategy period and an assessment of the organisational structure was carried out. The introduction of programme-based working has been received positively, both internally and by our external stakeholders. Because NLR's demand-driven programmes are aligned with our value and impact propositions, they provide focus and synergy between market orientation and knowledge orientation. During the stakeholder days, this structure also showed that the programmes are an effective way of approaching and engaging stakeholders. Policy was developed further during the past strategy period in areas such as internships and graduates, PhD students, staff exchanges and research infrastructure, with the aim of strengthening relationships and cooperation with universities further. In addition, a policy has been introduced for publications, with the intention of passing relevant knowledge and information on to society, in a broader sense. As a result, NLR's visibility and voice as an independent provider of facts in the public debate have increased.

Finally, a process of structure evaluation and future-proofing of our organisation's top management has been initiated, taking account of the challenges facing the aerospace sector. Following that evaluation, a new top management structure was created consisting of three statutory directors: the CEO, CFO and CTO. The new management was put in place in June 2025. An important change in the board's composition is the appointment of a CTO who is responsible for aligning NLR's research and its research facilities with fundamental research at universities and the knowledge needs of the Dutch government, industry and SMEs. This also covers knowledge exchange, knowledge security and strategic relationship management with an emphasis on technology.

1.2 Looking ahead

Strategy period 2026–2029 and beyond

This strategy period will see us face huge challenges in terms of security, competitiveness and sustainability. Scenarios that see a NATO member state attacked and the Netherlands becoming involved in a war could become reality. Accelerated reinforcement of Europe's economic power, innovation capacity and strategic autonomy is needed. Moreover, there is now a need to invest even more heavily to achieve the objectives of the Paris Climate Agreement: if greenhouse gas emissions are not cut at an accelerated rate from now on, the targets will no longer be achievable [9]. ESA stresses too that the sustainability of space use is coming under increasing pressure and that the way we currently use space is not sustainable in the longer term [14].

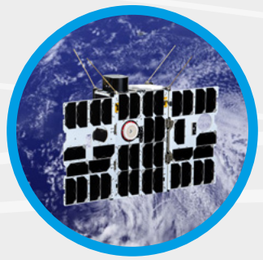
The long-term themes chosen for the previous strategy period – namely 'Aerospace for a Safe and Secure Society', 'Strengthening Competitive Aerospace' and 'Sustainable Aerospace' – therefore remain as relevant as ever for the coming period. National and international developments in recent years have shifted the focus in Europe and the Netherlands away from sustainability towards safety and competitive capacity. As a result, the themes are more closely intertwined than ever before. We will therefore concentrate explicitly during this strategy period on the areas where the themes converge, with more emphasis on a safe and resilient society, along with reinforcement of the competitive capacity of our aerospace sector. We have already taken steps towards our long-term goals within these themes (see Infographic 1 for the key points). NLR will be resolving issues flexibly and at an accelerated pace during this strategy period. While doing so, we will maintain a healthy balance between short-term research on the one hand and developing knowledge and facilities needed in the longer term on the other, so that we can continue to support the Dutch government and industry in the future.

At the same time, we note that research and innovation resources and research infrastructure are under pressure. The Schoof cabinet is cutting back on education, research and innovation; the National Growth Fund is being phased out; the Applied Research Facilities (hereinafter "FTO") instrument for investing in high-quality, future-proof research facilities will be discontinued. It is expected that the tenth European framework programme will no longer have aviation as a separate programme but that it will be part of a broader mobility programme. As things stand at present, an accompanying national programme is a prerequisite for participating in the framework programme. NLR will therefore work both domestically and in Europe on positioning aviation as an essential and integral part of the major mobility questions. An additional challenge here is that social and political pressure on aviation in the Netherlands is so high that the wheels have been set in motion to restrict commercial air traffic volumes, at a time when growth on a global scale seems however to be continuing. Aviation no longer has a privileged position in the Netherlands and must earn its place in the sustainable mobility system. Dutch spaceflight resources are also insufficient for a progressive high-tech knowledge economy such as the Netherlands, despite its huge importance being widely recognised [4,15]. In contrast, the Ministry of Defence is investing heavily in space capabilities, under the Defence Space Agenda [5] and the 2022 and 2024 Defence Memoranda [2,12], which offer opportunities for growth in the Dutch space industry.

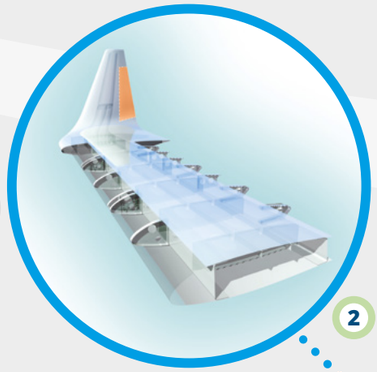
1.3 Reader's Guide

The NLR's management structure changed in June 2025, after this strategic plan was completed and submitted to the Ministry of Economic Affairs and Climate Policy (hereinafter also "EZ"). To give the new board the opportunity to influence the strategic structure and the formulation of concrete objectives, it was decided that the strategy plan you are now reading should be primarily indicative; the details of the strategy will follow in one or more concrete implementation agendas that will be drawn up by the new board in the second half of 2025.

Chapter 2 gives an internal analysis of NLR's strategic position and an external analysis of the macro-factors. After that, Chapter 3 describes the strategic direction and the goals for this strategy period. Chapter 4 sets out the principles for the strategic direction, aiming to innovate together with Dutch industry, SMEs, other centres of expertise and the government authorities in order to achieve the maximum possible social and technological impact.



Small satellites



Future Wing

Hydrogen-powered Pipistrel

Manned and unmanned aviation

Drone Swarms

Information-driven operations

1 Within the 'Sustainable Aerospace' theme, with the goal of making aviation climate-neutral by 2050, we were aiming for a manned demonstration flight using liquid hydrogen in 2025. We carried out research into a liquid hydrogen powertrain that could be integrated into our research aircraft, the Pipistrel Velis Electro. We collaborated with two Dutch SMEs: zepp.solutions for the fuel cell and Cryoworld for the hydrogen tank. This let us develop specific knowledge for the transition to sustainable aerospace, for industry sector stakeholders, operations and the government. The demonstration flight has been postponed to 2026 and will be done using a 'permit to fly'.

2 Within the 'Competitive Aerospace' theme, we developed an innovative technology demonstrator. Its components include a deforming wingflap with integrated state and condition monitoring that increases the efficiency of the platform and avoids unnecessary maintenance. The design was presented during the 2024 ILA Berlin Air Show, after which work commenced in 2025 on producing it. This has made manufacturing and maintenance techniques available to the industry for the next generation of low-emission aircraft. The study will continue in 2026.

3 Within the 'Competitive Aerospace' theme, our aim was to work with the aviation sector and governmental bodies to create solutions that will improve the efficiency and resilience of the aviation system. During the 2022–2025 strategy period, operational airspace concepts were developed and demonstrated at the stakeholder days. This included the integration of manned and unmanned aviation. The research that was carried out has given us an understanding of applicable solutions for a renewed, efficient and resilient aviation system. This will give airspace controllers and users some new options for organising airspace operations. This will all help improve both safety and competitiveness in the way Dutch airspace is used.

4 Within the 'Competitive Aerospace' theme, with one eye on the Dutch position in the aerospace sector, we had intended to develop a miniaturised instrument with high resolution and onboard data processing. Developing and demonstrating the technology in the space domain did not seem opportune in the 2022–2025 strategy period; a decision was made instead to develop the same technology in the more accessible UAV domain and demonstrate it in a scenario with live, virtual and constructive components. The knowledge acquired can benefit competitiveness and help keep our society secure.

5 Within the 'Aerospace for a Safe and Secure Society' theme, we had set targets relating to information-driven, multi-domain and integrated operations. The cognitive effects of military operations have been mapped out theoretically and incorporated into a conceptual model in a simulation environment. The model offers a step-by-step plan for simulating human behaviour in multi-domain, information-driven operations. The research has provided a deeper understanding of the effects of cognitive aspects in warfare. This directly plays a part in keeping society secure.

Infographic 1: A review of the main results from the showcases of the 2022–2025 strategy period

We are dedicated professionals who push the boundaries enthusiastically, courageously and determinedly

2. 2. Strategic position and situation

Internal and external analyses have been carried out to determine NLR's strategic position at the national and international levels. Those analyses are described in this chapter. At the same time, we look at how NLR distinguishes itself from other parties (positioning) and how it asserts itself and adds value constructively (profiling).

2.1 Internal analysis

Who we are

For more than 105 years now, the Royal Netherlands Aerospace Centre has been a leading and independently operating applied research organisation for aerospace, focusing on technological and social challenges. We carry out our work in line with the Dutch Code of Conduct for Scientific Integrity [16]. Our technology development focuses on applied research. NLR collaborates with universities on fundamental research. In applied research, we collaborate with other Dutch applied research institutions (TO2) and similar organisations abroad. NLR is a strategic knowledge partner for the Dutch Ministry of Defence. We aim to maximise our impact by collaborating with the commercial sector and governmental authorities.

After some inspirational meetings in 2025 about our own collective goals, in which the staff shared their ideas and expectations, we have given an outline below of how we see ourselves:

We are dedicated professionals who push the boundaries enthusiastically, courageously and determinedly in the aerospace sector. Combining trust and freedom with expertise lets us turn fledgling ideas into significant innovations. We have an inspiring work environment where we can excel together and offer solutions for complex issues, both now and for future generations.

This is the foundation on which we have developed our vision of leadership, which defines the principles, behaviours and impact of our leading position. The essence of this vision is:

NLR's leading position sets out the direction and gives confidence for pushing the boundaries of innovation and creating an impact together.

OUR MISSION

In its role as an applied research organisation, Royal NLR is making aerospace more effective, safer, more sustainable and more efficient.

Our innovative and practical solutions and technical expertise contribute to the safety of our society and increase our effectiveness, reinforce the Dutch commercial sector's competitive position and help find solutions for social issues. We carry out our research objectively and independently, both for and with the national and international commercial sector, governmental bodies and research organisations.

Our position – knowledge and technology

NLR occupies a central position in both national and international aerospace research and in the innovation ecosystem. In Europe, we collaborate with our sister organisations in the Association of European Research Establishments in Aeronautics (EREA) and the Association of the European Space Research Establishments (ESRE).

We are also active in supporting the Dutch Ministry of Defence and we collaborate with industry and TO2 institutions in relevant European Defence Agency (EDA) CapTechs (Capability Technology Groups). We participate in major EU programmes for research and innovation, including Horizon Europe and the European Defence Fund (EDF). NLR involves the Dutch commercial sector – SMEs in particular – as much as possible in these programmes. At the global level, NLR looks for links through the International Forum for Aviation Research (IFAR).

We are the connection between scientific research, policy-based support and practically oriented industrial development. There are areas where our wide-ranging knowledge and technology are at a world-class level. We use our research infrastructure to test the effects of new technology experimentally and assess the feasibility of novel concepts, as well as to gain knowledge that will help technological developments progress and help resolve society's challenges.

To align our knowledge development with fundamental research, our strategic collaboration with universities is important and was strengthened further during the past strategy period. We maintain structural contacts with professors and subject teachers, give guest lectures, and employ a part-time professor at NLR. We also have universities involved in our advisory board and advisory committees. At the operational level, we utilise each other's capabilities by (for example) deploying interns, graduates and PhD students and by sharing the use of research infrastructure. Every year, NLR offers a large group of vocational (both lower and higher) and university students a chance to contribute actively to knowledge development at NLR through their internships or graduation projects; PhD students can carry out scientific research for NLR.

Cooperating with businesses and the authorities is essential for effective valorisation of our knowledge and for creating impact. We do this by accelerating innovations, improving their effectiveness and by enabling testing, verification and validation using our infrastructure, as well as by transferring knowledge and technology. This is how we are aiming to be a major linchpin in the Dutch ecosystem that strengthens our economy and our society. We are not unique in the Netherlands in that respect and intensive horizontal cooperation within the TO2 context is important if we are to maximise this impact. NLR and TNO have for instance agreed on further intensification of their cooperation on defence and security in the sense of the scalability and flexibility demanded by the Ministry of Defence in order to respond effectively to rapid changes. To that end, a specific joint staff unit called the Military Use of Space Community has been set up to develop our common knowledge about the space domain further efficiently and to make it available to the ministry effectively for their purposes. Another example is our joint research with MARIN on operating drones from ships.

"Knowledge valorisation": Knowledge valorisation is the process of creating value from knowledge by making it suitable and/or available for economic and/or social use and transforming it into products, services, processes and new business activities.

Source: www.rathenau.nl

Positioning our research infrastructure

NLR's physical and digital research infrastructure plays an essential role in knowledge accumulation and technology development for aerospace and in accelerating the realisation of the necessary innovations. Knowledge development and experimental verification are deeply intertwined. Among other things, the research infrastructure helps reduce risks by testing the technological feasibility of new concepts or investigating the limits of the area where a platform can be applied. Other examples where our facilities play a key role are shortening the time to market for new systems and products and training, simulation and concept development, and experiments that lead to new or improved defence capabilities. Large-scale research infrastructure does not generally cover its own operational costs, so commercial companies do not invest in it. To tackle this area where market forces do not work, TO2 institutions have a position within the innovation system that lets them develop and manage strategic research facilities.

This is one of the key tasks that the authorities impose upon TO2 institutions. NLR manages and commercially operates large research facilities that are unique in the Netherlands, and in a few cases even internationally. It is therefore essential that the government provides funding arrangements to meet the shortfall in commercial returns and that these facilities get updated.

As well as developing and managing its own facilities, NLR also collaborates in major research facilities. Together with its German counterpart DLR, NLR set up the German-Dutch Wind Tunnel Foundation (DNW) in 1976. DNW is a leading organisation in aerodynamic and aeroacoustic experiments for the civil and military aerospace industry, the automotive industry and research organisations. The simulated flight conditions range from take-off and landing conditions to measurements at speeds of Mach four.

In the TO2 context, NLR is working with others to develop a virtual collaboration environment (DigiLab) that focuses on digital innovation, technologies and solutions. We also have linkable battle labs that can be used for studying complex multi-domain issues realistically for the Ministry of Defence.

Furthermore, NLR is collaborating with DNW, RDW, the municipality of Noordoostpolder, the province of Flevoland, the police and educational institutions to develop a knowledge and testing centre for smart mobility: the Mobility and Infrastructure Test Centre (MITC). This development was formally ratified in 2019 when the Northern Flevoland Regional Deal was signed. Autonomous and other mobility concepts for the future are developed, tested and certified in the MITC for the future of countries. Additionally, the MITC acts as a campus. It is a physical location close to the NLR site in Flevoland where start-ups, scale-ups, SMEs and large companies can set up, permanently or temporarily. The purpose of the campus and its location is to make NLR's knowledge more available, encourage valorisation and make our facilities more accessible. A final example is the development of the QRDF at NLR in Marknesse to allow rapid drone development together with the industry for the Ministry of Defence.

"DNW, cooperation between Germany and the Netherlands":
Back in the sixties, an urgent need arose at NLR for more modern and larger wind tunnels. It was a period when developments in aviation were increasingly focused on improving safety (particularly during take-off and landing), improving fuel consumption and reducing noise pollution. This drove a greater focus on the flight characteristics of aircraft at low speeds and research into noise reduction measures. Research in this field was impossible in the existing wind tunnels because of the high noise levels in the tunnels themselves combined with their limited dimensions.

In 1971, NLR presented a design for a new and much larger low-speed wind tunnel. Because such a wind tunnel was also needed in Germany, the two governments asked for a study to be carried out to see if a single wind tunnel that met the needs of both countries would suffice. This led to the establishment of the Duits-Nederlandse Windtunnels foundation (German-Dutch Wind Tunnels, "DNW" elsewhere in this document) in 1976 and the construction of the Large Low-speed Facility (LLF), which is still the largest wind tunnel in Europe. NLR and DLR each own fifty per cent of this foundation. Over the period from 1996 to 2000, the management and commercial operation of other wind tunnels belonging to NLR and DLR were placed under the auspices of DNW.

The importance of DNW for the Netherlands is considerable, in economic, scientific and strategic terms. DNW draws in major international aerospace companies such as Airbus, Lockheed Martin, Embraer, KAI, Rolls-Royce, Safran, Dowty, space agencies and the defence industry. This lets the Netherlands take up crucial positions in strategically important value chains in the international aerospace industry, which benefits Dutch companies and centres of expertise. The DNW facilities are essential for aerospace research and development and let the Netherlands play a significant part in major European programmes such as Clean Aviation, Horizon Europe and EDF. Wind tunnels are used in research and development in both the civil domain (new technology that contributes to cleaner aviation, such as electric or hybrid powertrains, and aerodynamic or aeroacoustic improvements) and the military domain (testing new platforms, modifications to existing platforms and weapons systems). As well as their primary function in the aerospace sector, the DNW wind tunnels are also used in the maritime, automotive and energy sectors, and elsewhere.

Close collaboration with SMEs and start-ups

How are we doing

FOR OUR EMPLOYEES

Once every eighteen months to two years, a survey is carried out among our employees to give us a clear picture of their satisfaction and engagement. What motivates them or holds them back, and how do they perceive NLR as an employer? This is done using the Medewerkersmonitor (staff monitor, MeMo) and it is carried out by an external organisation. The key results in 2025 were:

- The employees are enthusiastic about their work, with the reasons including that they appreciate the culture, feel valued, and are given the opportunity to do what they are good at. They feel it is an inclusive working environment where they can be themselves and are accepted for who they are. Staff feel socially secure and play their part in a positive working environment. There is a large group of 'ambassadors' who very much want to continue working for the organisation.
- People get a sense of good collaboration and good dynamics in the teams. It is possible to make improvements in efficient cooperation and in the efficiency of working processes within the teams.
- Those in leadership roles play important (and in most cases positive) roles for the staff.
- It is possible to make improvements in providing feedback on performance and address behaviour issues.
- About a third of the employees perceive the working pressure as high or excessive, with the three key reasons being too few colleagues, too high an administrative burden and changing priorities.
- About a third of the employees see remuneration as the key issue for improvement.
- The organisation's goals could be more clearly formulated for the staff.

At various points in between, we carry out targeted measurements to examine specific themes that emerge from the MeMo and require additional attention. This approach lets us monitor developments and trends better, make adjustments in good time and take targeted improvement measures.

FOR OUR EXTERNAL STAKEHOLDERS

The socioeconomic impact of our research, development and innovation occurs when our clients and stakeholders utilise our knowledge and technology and apply it successfully. Introducing programme-based working yields more clarity and control for achieving the impact that our stakeholders want to see.

Clustering national and European projects within our programmes around their intended impact makes the coherence and synergy visible, increasing the effectiveness and thereby reinforcing the impact of our research. NLR actively involves Dutch companies in national public-private partnership programmes such as Luchtvaart in Transitie and European research programmes. This brings them on board as suppliers for important European original equipment manufacturers (OEMs) such as Airbus, Leonardo, Safran and Dassault. NLR participates in European working groups and is committed to ensuring that Dutch companies are well-positioned and involved in European research and development programmes from an early stage. Industrial participation, in particular early involvement of the relevant parties, allows NLR to work closely with SMEs. This shows how NLR is committed to promoting the Dutch ecosystem, linking it inextricably to the value chains of the major international OEMs.

"SME": ": small and medium-sized businesses or SMEs is a collective name for the business sector that according to the Netherlands Enterprise Agency (hereinafter "RVO") comprises three types of ventures.

Size	Number of employees	and annual turnover	and/or annual balance
Medium-sized	Fewer than 250	no more than € 50 million	less than or equal to € 43 million
Small	Fewer than 50	no more than € 10 million	less than or equal to € 10 million
Micro	Fewer than 10	no more than € 2 million	less than or equal to € 2 million

Source: RVO

Within this group, NLR focuses in the first place on high-tech, knowledge-intensive and capital-intensive start-ups and scale-ups. Start-ups are those still looking for scalability and repeatability for their business models, whereas scale-ups are already at a more advanced stage; they are rapidly growing ventures that by now have a proven business model. NLR supports both types of companies during development of technological innovations that still come with risks that are numerous – or indeed too many – for the companies alone.

As well as operational cooperation within projects, we collaborate at a strategic level with e.g. the Ministry of Defence, TO2 institutes, Delft University of Technology, the University of Twente, Eindhoven University of Technology, DNW and DLR to develop, innovate and maintain knowledge and facilities. NLR's position as a strategic knowledge partner of the Ministry of Defence lets it act as a fully-fledged and proactive player, contributing to both the day-to-day deployment and future development of the armed forces. One way we do that is by participating in relevant taskforces, secondment of NLR staff to crucial positions within the Defence department and secondment of their staff to NLR.

The most recent evaluation shows that our impact is perceived as being good or extremely good [17]. National and international stakeholders value the research and services we provide highly. That is evident from the stable client base and the structurally high customer satisfaction scores, which have ranged from 4.42 to 4.45 out of 5 since 2021.

FINANCIAL

NLR's financial policy is robust. We have shown that we take appropriate measures to mitigate the effects of global crises and are resilient when dealing with fluctuations in government funding and contributions from national and international financing instruments. NLR is financially healthy, both now and in the longer term. We anticipate demand for NLR's services increasing further during this strategy period because of the important and extensive social challenges.

EMTO

On instructions from EZ, all TO2 institutions were assessed at the end of 2024. Independent committees evaluated the TO2 institutions against the guidelines of the EMTO protocol developed by the Rathenau Institute. The assessment of the institutions' performance is based on three main criteria, namely quality, impact and vitality. This is reported directly to the minister of EZ in their capacity as the coordinating figure who is also responsible for the system on behalf of the TO2 institutes.

The evaluation committee's assessment in the latest round of evaluations was that our research is very good in terms of both quality and impact [17]. The committee sees the breadth of NLR's knowledge base – in terms of themes and research activities – as providing added value and recommends maintaining this breadth as it leads to continued flexibility and adaptability for when new trends and developments appear. Compared to the previous evaluation, the committee believes that NLR has taken significant steps as regards vitality; they recommend that the improvements made in personnel policy should be continued. Given the need to increase the competitiveness of the Netherlands and Europe, the committee recommends that NLR should intensify dialogues and cooperation with start-ups, scale-ups and SMEs and develop a valorisation strategy. To provide a better understanding of the impact and quality of our research, the evaluation committee recommends developing a monitoring system to that end. Finally, the committee concludes that NLR, in collaboration with the governmental authorities, needs to develop a structural methodology for maintaining large research facilities and investing in them. NLR is happy to take the committee's recommendations on board and has included them in this strategy.

2.2 External analysis

Security

The security climate worldwide is worsening. Power blocs are competing for influence in regions, markets and scarce resources, and for technology. The conflict in Ukraine underlines the importance of strong defence in Europe and highlight Europe's dependence: in military terms, without the US as a NATO ally, Europe is vulnerable. In the meantime too, Europe's economic security is coming under severe pressure because of trade wars and the advent of protectionism: governments are acting in the primary interests of their own industries. Conflicts, regime changes and shifting power relationships in the Middle East, closer alliances between Russia, North Korea and Iran, the rise of artificial intelligence (AI), political interference by big tech and protectionist measures, particularly affecting exports of critical raw materials, are factors that could all engender geopolitical and economic instability and insecurity [18,19].

The Dutch armed forces are therefore concentrating once again primarily on their principal task, protecting our territory and that of our allies. The various conflicts around the world make it clear that air power and sufficient air defences are indispensable for keeping the Netherlands and Europe safe. The dependency on space power in conflicts has also become manifest. In addition to sufficient autonomous capabilities, this demands a strong, integrated multi-domain decision-making chain plus sufficient, properly educated and trained military personnel and the requisite training facilities for them. We are seeing a sharp uptick in hybrid threats that take forms such as cyber-attacks, sabotage, disinformation and increasingly blatant interference in elections in Europe. These hybrid threats require strong cooperation between civilians and the military to ensure our day-to-day security and protect our democracy.

EEurope recognises the importance of ameliorating excessive dependencies in defence, critical raw materials and energy sources, and of increasing security and resilience. Overall defence spending by EU member states increased by over 30% between 2021 and 2024, and spending is expected to increase further in the coming years [20]. The Netherlands too is investing heavily in strengthening, growing and scaling up its armed forces. Scalability lets the armed forces deploy capabilities (including personnel, equipment, infrastructure and knowledge) manageably from within the organisation and society within a relatively short period if the security situation so demands [12]. This means that research organisations must also adapt and prepare for scalability. Because of the changed security situation, the Ministry of Defence is concentrating on cooperating more intensively with research organisations and the commercial sector so as to enhance Dutch and European strategic autonomy [21]. The aerospace sector is extremely important for this. After years of underinvestment and equipment procured from non-European suppliers, the European military aviation sector has in recent years been focusing strongly on growing and investing in its in-house development in order to reduce European dependence on third-party countries and the associated security risks [22]. There are a variety of European industrial programmes for developing advanced combat aircraft, including the Future Combat Air System and the Global Combat Air Programme.

Moreover, the EU wants to strengthen the EU's military capabilities through its Readiness 2030 strategic plan [23]. The defence industry plays a crucial role in supplying the requisite volumes of systems, equipment and related services such as maintenance, repair and overhaul (MRO) at any given time in order to guarantee the superiority of European armed forces. In addition to getting our physical equipment in order, strengthening our digital resilience is a priority for socioeconomic security. Dutch and European society and the economy are dependent on secure and reliable digital products and connections. This dependency is only going to increase in the years to come, meaning that our cybersecurity will need to be strengthened further.

The European space sector is strategic and essential for implementing many governmental policies and for supporting all economic sectors [22]. Applications in communication and navigation, monitoring and surveillance of critical infrastructure, secure interbank payments and environmental and weather monitoring would not be possible without a space infrastructure. Space has been officially recognised by NATO since 2019 as a military domain, prompting more and more countries (including the Netherlands) to establish military space entities [24]. The Long-Term Space Agenda (hereinafter "LTR") for the Netherlands is devoted to a fully-fledged national space programme and to increasing the level of investment so that a significant role can be played in safeguarding strategic autonomy for Europe and the Netherlands [4]. The Defence Strategy for Industry and Innovation 2025-2029 (D-SII) [25] provides the policy underpinnings for integrated strengthening of both defence capabilities and the Dutch economy. Space technology has been picked as one of the five areas for targeted defence development (hereinafter the "NLD" areas) [26]. Access to space and data obtained using space capabilities is important not only for security but also for the economy and for achieving sustainability targets.

[1] *Lex Besselink (chair), Prof. Margot Weijnen, Lt.-Gen. (retd.) Mario Verbeek and Kees de Koning.*

The Netherlands has set itself the target of investing at least 3% of GDP in R&D by 2030

Economy Economy

The global economy is expected to grow moderately until 2030 [27,28]. Economic growth in Europe has slowed down significantly since 2023 thanks to the ongoing energy crisis, high inflation and increased uncertainty caused by geopolitical tensions [29]. The International Monetary Fund (IMF) cites ageing population profiles and poor productivity as key structural causes of the slowdown in potential growth in many economies [27]. Europe is the continent with the oldest profile and its population is expected to decline until 2050 [30,31]. Declining populations with ageing profiles in both Europe and the Netherlands are leading to a shrinking workforce and increased pressure on labour productivity.

In his report to the European Commission (EC) on the future of European competitive capacity, Draghi concluded that Europe is lagging behind the US and China in terms of productivity growth, largely stemming from being behind in digital technologies and from high energy prices and additional security considerations in economic policy [8]. The EC realises that a declining workforce means that Europe cannot rely on increasing labour boosts to stimulate future economic growth. At the same time, though, the Commission observes that Europe has been insufficiently successful in converting ideas into new, marketable technologies and then integrating them into its industrial base [32]. To implement the recommendations in the Draghi report, the EC wants productivity growth that focuses on accelerated, disruptive innovation that is driven by new, dynamic start-ups and efficiency gains in traditional industries that apply these innovations. Europe wants to be in the vanguard of innovation in technological sectors that are important for the economy of tomorrow, such as AI, semiconductor and quantum technology, advanced materials, biotechnology, clean energy technology, robotics, space technology and connected and autonomous mobility. Draghi states that Europe is lagging way behind its competitors in terms of investment in the defence and aerospace industries and that these sectors are too fragmented. Regarding the space domain, the conclusion is that Europe has developed a strong technological position but is now rapidly falling behind. Europe is chasing the pack, particularly in space flight's largest market areas – rocket propulsion, mega-constellations for telecommunications, satellite receivers and satellite applications.

The EU's biggest publicly funded research and innovation programme is the ninth framework programme, named Horizon Europe. This programme runs until 2027 and will probably be succeeded by a tenth framework programme from 2028 onwards. It is expected that a parallel national programme will be a prerequisite for participation. Public funding alone, though, will be insufficient to allow enough investment in innovation; private capital will also need to be involved on a large scale. The EC intends to mobilise private sector sources of funds and target them at future-oriented growth sectors..

The Netherlands has set itself the target of investing at least 3% of GDP in R&D by 2030, with public and private proportions remaining equal (the Lisbon Target) [33]. R&D yields new and improved products and services, as well as improving labour productivity. Examples include automating production processes, labour-saving innovations and more energy-efficient equipment and installed systems. The Dutch government believes industry to be essential for making energy consumption more sustainable and for the transition to a circular economy. Industry plays a major role in developing digital and other key technologies and in occupying crucial positions in strategically important value chains such as aerospace and defence [34]. Through its mission-driven innovation policy, the government is boosting the economic earning capacity of the Netherlands and the development of innovative solutions to society's challenges. Efforts will be made to strengthen research and innovation ecosystems and campuses where businesses and centres of expertise collaborate [33]. The Dutch government is encouraging further development of key technologies that make this possible. The National Technology Strategy (NTS) has identified key technologies that could let the Dutch knowledge sector and commercial sector have a positive impact and create a unique position for the country [35].

In technology and innovations for defence applications, the Netherlands is focusing on the five NLD areas: smart materials, sensors, quantum, space technology and intelligent systems [36]. The D-SII [25] provides strategic direction for strengthening these NLD areas through policy, management, investment and upscaling. The Dutch government sees a starring role for start-ups and scale-ups in this respect, as they contribute both to the technological leadership of the Netherlands and to the strategic autonomy of Europe. Many deep tech start-ups develop and commercialise high-tech solutions. A key point to note is that there is relatively little availability of venture capital and access to funding for start-ups and SMEs; the regulatory burden on businesses is also relatively high compared to other countries such as the USA [37]. These are significant drivers of start-ups leaving the Netherlands and Europe [38].

The presence of strategic technology companies enables the Netherlands to put innovative products or services on the global market and set the standards and values against which such technologies are developed. Protecting knowledge is an important aspect here. Collaboration with other EU member states is how the government is aiming to ensure that Dutch companies can secure and maintain key positions in strategic value chains, to strengthen the resilience of the Netherlands and the EU and to increase economic security. Civil aviation is essential for economic globalisation and for driving innovation. The sector's value chain is crucial in ensuring Europe's strategic autonomy in mobility technologies and plays a part in numerous advanced technologies with spill-overs that are relevant to other sectors. On top of the huge challenges posed by the green transition and the digital transition, the sector is facing supply chain bottlenecks, shortages of critical raw materials and electronic components, rising energy prices and trade restrictions that are affecting its competitiveness [22].

Climate and sustainability

At the UN Climate Change Conference in Paris in 2015, the Climate Agreement was adopted by 196 parties. The overall goal is to *"keep the increase in global average temperature well below 2°C above pre-industrial levels"* and to make efforts to "*limit the temperature increase to 1.5°C above pre-industrial levels*" [39]. Exceeding the 1.5°C threshold would carry the risk of far more severe climate change effects, including more frequent and severe droughts, heatwaves and rainfall [40]. A changing climate and extreme weather conditions now pose an ever-increasing threat to Europe's socioeconomic security [32]. Climate change also significantly affects the operations, resources and personnel of the Ministry of Defence [41]. Climate adaptation is therefore an important topic. Europe has strict legislation not only about the climate but also for biodiversity and nature restoration. One example of this is nitrogen deposition, which poses some substantial challenges, particularly for a small country such as the Netherlands with relatively large agricultural, industrial and aviation sectors.

To tackle climate change, the EU is putting efforts into measures that should make it climate-neutral by 2050. Some of the measures involve speeding up the transition towards a circular economy by promoting sustainable consumption and ensuring less waste. A circular economy can simultaneously reduce the EU's dependence on non-EU countries for critical raw materials [42]. The availability of crucial raw materials is essential for the aerospace sector, both civil and military. The Dutch government is committed to making supplies for the Netherlands more secure, inter alia by looking specifically at opportunities for stockpiling and processing in the Netherlands, as well as by developing ways of using critical raw materials circularly [43]. For the aerospace sector, there are opportunities to link up with the automotive sector for a circular economy; they already have experience with regulations for designing and managing end-of-life vehicles, aiming to protect the environment, remove CO2 emissions from production and reduce dependence on raw materials [44].

Other measures for progressing to climate neutrality focus on reducing greenhouse gas emissions. All economic sectors, including the transport sector (which includes aviation) are expected to contribute towards this. The EU wants to make mobility greener while guaranteeing connectivity throughout the EU [45]. To reduce emissions, the European aviation industry is concentrating on new aircraft designs that use less fuel, the adoption of lighter materials and the development of alternative propulsion systems, such as hybrid and electric drivetrains. The MRO sector plays its part in sustainability by extending service life and reusing components, and by developing smarter, more efficient and more environmentally friendly solutions. In aviation operations, emissions can be reduced by e.g. optimising flight routes and electrifying ground handling. Furthermore, the use of more sustainable aviation fuels is enforced through a blending obligation defined in ReFuelEU. The free ETS rights for aviation will also be cut back further and airlines will be required to report on non-CO2 emissions from 1 January 2025 onwards. Following the European example, the aviation sector at the global level has also agreed on net-zero CO2 emissions as a target for 2050 [46]. This is underpinned by scenarios that make it seem plausible that this can be achieved. Cumulative emissions are not addressed in these, though; 2050 is still a long way off, while all emissions in the meantime are also contributing to climate change and to any tipping point being reached earlier. A net-zero CO2 emissions target for 2050 has not yet been agreed at the Dutch Sustainable Aviation Roundtable (DLT). However, the Dutch goal regarding greener aircraft fuels remains higher than the European blending obligation (at 14% compared to 6% by 2030).

Europe is leading the way when it comes to sustainability targets and this is increasingly being enshrined in its policy and regulations. The EC has relaxed the Corporate Sustainability Reporting Directive (CSRD) and put back its implementation to reduce the administrative burden on companies in the short term and to boost their competitiveness. However, the long-term expectation is that more and more companies in Europe will have to report on the impact of the entire value chain, similarly to how this is done for financial reporting. Sustainability is thus increasingly becoming part of standard European business processes.

[2] *Optical systems and integrated photonics, quantum techniques, process technology (including process intensification), biomolecular tech and cell tech, imaging techniques, mechatronics and optomechatronics, AI and data science, energy materials, semiconductor technologies, and cybersecurity technologies.*

[3] *A knowledge-intensive and capital-intensive start-up, scale-up or SME with a high-tech solution. The following technologies are referred to as deep tech: AI, blockchain, cybersecurity, robotics, advanced manufacturing (including 3D printing), microelectronics (including semiconductors), photonics, quantum computing, advanced materials and/or biotechnology. (Parliamentary Paper 32637, no. 567)*

2.3 Conclusion

In terms of security and competitiveness, the Netherlands and Europe as a whole are in a complex area and being pulled in various directions. Geopolitical tensions and a deteriorating security climate have created an urgent need for investment in defence, space flight and technological innovations, so as to accelerate the improvements in Europe's strategic autonomy and security. Our armed forces are concentrating once again primarily on their principal task, i.e. protecting our territory and that of our allies. The various conflicts around the world make it clear that air power, space power and adequate air defences, good intelligence and integrated multi-domain decision chains are indispensable for keeping the Netherlands and Europe safe. That is why we are placing greater emphasis in this strategy period on the theme of "Aerospace for a Safe and Secure Society".

An ageing population, a shrinking workforce, high energy costs and a weak position in digital technology are limiting the competitiveness of the Netherlands and Europe. Strict regulations and limited availability of venture capital in the Netherlands are moreover leading to the country's international position deteriorating and capital-intensive and knowledge-intensive start-ups, scale-ups and SMEs leaving. For NLR's strategic direction, this means putting a heavier emphasis on accelerated innovation, knowledge valorisation and increased competitiveness of Dutch businesses (capital-intensive and knowledge-intensive start-ups, scale-ups and SMEs in particular), on supporting the Ministry of Defence and the defence industry, and on conducting space technology research. "The competitive capacity of aerospace" is more relevant than ever as a theme.

NLR can play a more prominent role in creating a less regulated environment for companies to experiment in. Additionally, NLR can assist the governmental authorities in improving existing regulations and in developing policies and regulations where those are not yet present.

Europe is in the sustainability vanguard in terms of targets, regulations and technological developments and is committed to a sustainable mobility system, of which aerospace is a part. This offers opportunities for the Dutch aerospace sector to develop new, green technologies and export sustainable solutions. The sector's value chain is crucial in ensuring Europe's strategic autonomy in mobility technologies and plays a part in numerous advanced technologies with spill-overs that are relevant to other sectors. "Sustainable aerospace" remains an unabatedly important theme. What this means for NLR's strategic direction is that stronger links for sustainability must be forged with other high-tech sectors. On top of that, we are seeing that green technology in the civil domain can present opportunities for improving the autonomy and sustainability of the Ministry of Defence and can therefore be dual use; NLR can play a role in this.

Air power and space power protect our national territory

3. Strategic direction

The internal and external analyses from the previous chapter have been used in this chapter to determine the strategic direction.

3.1 Vision

Royal NLR wants to accelerate high-impact innovations to build a safe, resilient and economically strong society in the Netherlands and Europe, climate-neutral aviation and sustainable and safe use of the space domain.

Knowledge and innovation are the cornerstones of competitive strength. New knowledge acquired from research is used for instance to develop promising, new or improved products, processes and technologies. These innovations can add unique value, such as higher efficiency or solutions that can be applied, commercialised and scaled up, making sure that companies are in a strong position to compete. In the coming period, innovation will be more crucial than ever before in making the Defence department effective and sustainable and making the Dutch civil and military aerospace sectors more competitive.

NLR is an important part of the Dutch and European research and innovation ecosystem. Key stakeholders here are the authorities, relevant companies, centres of expertise and educational institutions. In our role as an applied aerospace research organisation, we add value by developing relevant knowledge and making it available, disseminating it and applying it within this research and innovation ecosystem in good time. When doing so, we aim to achieve the greatest possible technological, social and economic impact.

NLR, as a research organisation, is responsible for conducting short to medium-term research that is guided by governmental policy issues, the operational support requirements of the Ministry of Defence, and economic issues that are strategically important to the commercial sector. The increased urgency of accelerating innovation and enhancing our competitive edge is leading to a sharper focus within the Ministry of Defence and industry on short-cycle innovation. This demands a different mindset from NLR – i.e. a different way of thinking and using skills – as an additional form of demand-driven short-term research aimed at gaining an understanding at an earlier stage of the impact a specific innovation will have on effectiveness.

Furthermore, NLR must ensure that curiosity-driven, long-term research builds up knowledge that will let NLR answer future policy questions and can thus contribute proactively to the debates within society. As part of that, we must take the lead on certain issues, carry out research outside existing policy frameworks, and assume the role of guiding the Dutch authorities and the commercial sector in this area.

Coordination and cooperation between the parties, regulations and resources also play a large role in a research and innovation ecosystem. NLR is a link between science, businesses, the authorities and society, consciously taking a pioneering role as that linchpin.

We actively involve Dutch companies in the various ecosystems; we also see it as part of our role here to act as a hub and connect governmental authorities and companies together. We coordinate knowledge accumulation and facility development with other TO2 institutions and universities and we use each other's facilities to maximise synergy and avoid overlap. It also means that we assist the governmental authorities in developing policies and regulations where those are not yet present. Thanks to our familiarity with the national and European research programmes, we can help Dutch companies find suitable public funding instruments to develop and validate their technologies further. Public funds are insufficient to finance all the necessary innovations, though. The access to private sources of finance is particularly important for start-ups and SMEs if we are to keep such companies in the Netherlands. NLR is investigating the possibilities for fulfilling a role for these companies during this strategy period. Specifically focused on defence, NLR is one of the partners in Defport, a public-private partnership platform in which NLR, TNO and MARIN work closely with the ministries of Defence and EZ (Economic Affairs and Climate Policy), the defence industry (NIDV), the employers' organisation (VNO-NCW), the high-tech sector (FME) and the Dutch Banking Association (NVB) to accelerate innovation, scale up equipment production and strengthen the security of supply.

3.2 Ambitions

The analysis in the previous chapter has led us to conclude that the course we set in the previous strategy period for the three strategic themes – "Aerospace for a Safe and Secure Society", "Competitive Aerospace" and "Sustainable Aerospace" – is still relevant. The three strategic NLR themes are closely interlinked. More than that: they should be seen as inseparable. Moving on from the previous strategy period, the goals for the themes have remained consistent. We will therefore basically continue to pursue our course during this strategy period, including the long-term ambitions we formulated for these themes such as supporting the Ministry of Defence in procurement, operational deployment and the implementation of its vision and strategy, and in making climate-neutral aviation possible by 2050, so that we can achieve a lasting impact. The changing geopolitical situation and the increased interdependence of the themes means that we will concentrate explicitly during this strategy period on the areas where the themes converge, with more emphasis on a safe and resilient society, along with reinforcement of the competitive capacity of our aerospace. The importance of sustainability remains undiminished. We have formulated targeted ambitions for the areas where the themes overlap, as visualised in the diagram.

NLR RESOLVES ISSUES RAPIDLY AND FLEXIBLY

Appropriately anticipating developments demands flexibility to act quickly. Our stakeholders are focusing increasingly on short-cycle innovation. We are going to assist them in this with a fast innovation lane, in addition to our existing structure for building up knowledge. The first examples of how this will be done include the joint development with TNO of an acoustic detection system for the Air Force within three months [47] and the development of the Quick Response Drone Facility (QRDF) at NLR in Marknesse, in which we worked with the Ministry of Defence, centres of expertise and industry to let us get new drone functionalities operationally available within six weeks. In addition, we are studying how we can utilise technology from the civilian domain to accelerate military developments and vice versa (dual use).

AS A STRATEGIC PARTNER OF THE MINISTRY OF DEFENCE, NLR IS *THE* DRIVING FORCE ENSURING TIMELY AVAILABILITY OF THE REQUISITE CAPACITY, WORKING WITH THE COMMERCIAL SECTOR

Space and unmanned systems and integrated multi-domain operations are aspects that are gaining in importance rapidly. In addition, there are topics such as air power, air defence, and education and training; these are not new, but accelerated development is essential. NLR is a driving force here, accelerating these developments in order to increase the effectiveness and sustainability of the Dutch armed forces, in collaboration with the Ministry of Defence and the commercial sector. This boosts the Netherlands' strong role in Europe's strategic autonomy.

NLR ENHANCES THE FLEXIBILITY AND RESILIENCE OF DEFENCE OPERATIONS AND THE SECURITY OF SOCIETY BY DEVELOPING SUSTAINABLE SOLUTIONS

The energy transition that has been set in motion worldwide entails consequences for the availability of energy sources. Alternative sources of energy give the Ministry of Defence an opportunity to operate more autonomously and become less dependent on fossil fuels. The rapid rise of unmanned systems in defence operations presents an opportunity to develop systems that use alternative energy sources. Circularity offers options for becoming less dependent on critical resources. NLR is committed to developing these technologies in collaboration with industry, actively seeking connections with other sectors and applying knowledge we acquire in the civil domain to the military domain too.

Rapidly increasing utilisation of the space domain presents a growing challenge: preventing a significant portion of space from becoming filled with space junk that would render it impossible to use in the future. Given that the infrastructure built up in space has now become vital to how our society and our security function, sustainable and resilient use of space has become highly significant. NLR is focusing on developing technologies that let satellites operate sustainably, safely and resiliently.

NLR LINKS AVIATION WITH OTHER MODES OF TRANSPORT TO CREATE A FULLY SUSTAINABLE MOBILITY SYSTEM

Aviation is an important element of the Dutch and European mobility system. For any connection or journey in the future, the most sustainable combination of modes of transport should be weighed up. Developments in sustainability – such as smaller, electric and hydrogen-powered vehicles – are precisely the things that can lead to new mobility networks and allow Europe to compete in the arena of "green" transport technologies [8]. This will let innovations that promote sustainability boost earning capacity as well. NLR actively engages in dialogue and collaboration with partners both within the aviation sector and elsewhere, in the Netherlands and in Europe, to build knowledge together and cross-link existing knowledge.

A culture of trust, safety and appreciation that gives scope for initiative

4. Underlying principles for realisation

Following the exploration of the strategic position in Chapter 2 and further detail of the strategic direction in Chapter 3, this chapter describes the principles underlying the implementation agendas for realising the goals.

4.1 People en organisation

Employer of choice

We are well aware that attracting and retaining talented employees is crucial for realising our aim of being an employer of choice. That is why NLR puts its employees first. For us, it is not solely about good working conditions but also about creating an inspirational and safe working environment where the staff can feel involved, valued, supported and challenged.

To us, in line with our own collective ambition, an inspiring working environment means not only that there is a culture of trust, safety and appreciation that offers scope for initiative, professional and personal development and diversity, but also that we learn through collaboration and that our successes are celebrated. This needs appropriate leadership.

We see a safe working environment as an inclusive culture in which our employees are treated equally, feel they are valued and seen and heard, and where there is room for everyone to contribute. We are also fully aware of differences among people and respond consciously to the diverse needs of our employees.

As well as creating a safe and inspirational working environment, we are focusing increasingly on talent management. That means attracting, developing, retaining and optimising the potential of individual employees, all with the aim of helping them grow in their current roles and preparing them for their future at NLR.

The analyses in Chapter 2 show that the Netherlands and Europe will be confronted with some significant challenges in the next few years. At the same time, it is uncertain how these challenges will become manifest and what the impact will be on our organisation. What is certain is that it will demand flexibility and adaptability on our part.

We are therefore committed to further introduction of strategic personnel planning in order to build up a workforce that lets us respond flexibly to uncertain and evolving circumstances. This will ensure that NLR has the right people with the right skills in the right places, so that everyone can help achieve NLR's strategic goals. New staff are also being recruited to make sure that we have all the knowledge and skills we need to realise our ambitions.

A sustainable and flexible organisation

NLR needs to be a vibrant working environment where people inspire each other and are given the freedom and confidence to innovate quickly and flexibly. Our employees, with their knowledge and skills, are the cornerstones of our organisation. To be flexible and effective, it is crucial to have a diverse workforce with a variety of expertise, backgrounds and experience. That is why there has been a strong focus in recent years on creating an inclusive and diverse organisation with an eye on social safety, where people are unafraid to speak out and can address each other about behaviour.

The current divisional structure of the organisation is fit for purpose and sufficiently scalable. During this strategy period, where relevant, attention will be paid to the size and structure of the departments. One area of focus is ensuring that the size of our staff and support services stays in step with the rest of the organisation. We also aim to provide support for projects, which are becoming increasingly large and complex.

Our accommodation also has to remain right for the organisation. Our work for the Ministry of Defence imposes tough requirements on security and cybersecurity. NLR will be investing in its accommodation to create more on-site secure workspaces. Structural hybrid working is changing the requirements for office facilities and we will make yet more allowances for this.

We are setting up a clearer link between our knowledge base, demand-driven NLR programmes and our contract research, in order to give the research activities a more strategic direction in relation to the current and future needs of our stakeholders. This also includes further implementation of programme-based working. The Living Lab is a symbol of a free environment with few regulations where nascent ideas can be tested and given an initial impetus for development. A stronger link will have to be created with the knowledge base and programmes so that a structural contribution can be made and ideas brought to fruition.

AI is now indispensable, letting us proceed through process steps more quickly, make existing knowledge accessible and define potential solutions. We will develop a vision for AI that will allow us to reinforce our position as a research organisation and play a leading role in future developments and applications of AI in the aerospace sector. We will develop policies for using AI and for development of applications by our staff. We will investigate whether we can find ways of cooperating within existing regulations, for instance by linking our own SKY-GPT to other initiatives such as GPT-NL (TNO, SURF and NFI) and DEF-GPT (Ministry of Defence). We will be adding more functionality to SKY. In an ever-growing organisation, utilising the knowledge available e.g. in existing reports and among employees is an important aspect.

Corporate social responsibility is an essential component of the strategy for Royal NLR. We have been a member of the UN Global Compact since 2023, meaning that we consciously, deliberately and proactively play our part in a sustainable future by complying with the ten principles of the United Nations (UN) for responsible business operations that are designed to promote human rights and labour rights, protect the environment and combat corruption. Moreover, we ascribe to the UN's Sustainable Development Goals (SDGs). NLR has selected six SDGs and specific underlying objectives and has undertaken to make meaningful contributions (see Infographic 2). These goals are addressed to our employees (SDG 5, SDG 8 – embedded in HR policy), our organisation (SDG 12, SDG 13, SDG 16 – embedded in corporate social responsibility policy) and our knowledge and facilities development (SDG 9, SDG 12, SDG 13, SDG 16). Although NLR is not yet required to report under the CSRD, we do publish an annual sustainability report based on the Voluntary Reporting Standard for SMEs (VSME), which is derived from the CSRD. Reporting on a voluntary basis this way lets us make our sustainability performance transparent and clear, as well as proactively informing our stakeholders about our progress. Our goal is to be climate-neutral by 2030 in terms of our own emissions (scope 1 and 2) and by 2050 in terms of the emissions of the entire chain (scope 1, 2 and 3).

5 GENDER EQUALITY	**5.5****	Ensure women's full and effective participation and equal opportunities for leadership in political, economic and public life.
8 DECENT WORK AND ECONOMIC GROWTH	**8.5**	Achieve full and productive employment and decent work for all by 2030, including for young people and persons with disabilities, and to ensure equal pay for work of equal value.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	**9.5**	Enhance scientific research, upgrade the technological capabilities of industrial sectors, in developing countries in particular, also encouraging innovation by 2030 and significantly increasing the number of research and development workers per million inhabitants, as well as increasing public and private expenditure on research and development.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	**12.2** **12.5** **12.6** **12.7** **12.8**	Sustainable management and efficient use of natural resources by the year 2030. Substantially reduce waste generation by 2030 through prevention, reduction, recycling and reuse. Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability into their reporting cycle. Promote public procurement practices that are sustainable, in accordance with national policies and priorities. TEnsure by 2030 that everyone has the information and awareness needed for sustainable development and living in harmony with nature.
13 CLIMATE ACTION	**13.2** **13.3**	Integrate climate change measures into national policies, strategies and planning. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
16 PEACE, JUSTICE AND STRONG INSTITUTIONS	**16.a**	Strengthen relevant national institutions through international cooperation to build capacity, especially in developing countries, for preventing violence and combating terrorism and crime.

Infographic 2

* *VN Sustainable Development Goal*

** *VN-targets by Sustainable Development Goal*

Source: https://sustainabledevelopment.un.org

4.2 Knowledge and valorisation

Alongside our research infrastructure, knowledge is the strategic capital of the organisation. Creating impact among stakeholders by valorising what we know, the process of creating value from knowledge by making it suitable and/or available for economic and/or social use and transforming it into products, services, processes and new business activities, is one of our main tasks as an applied research organisation [48]. NLR is organised into areas of expertise, clearly defined collectives of topics of knowledge and aspects that departments are responsible for on behalf of NLR. They build up knowledge by carrying out research projects in the knowledge base and demand-driven programmes (financed by government contributions, approx. 30% of turnover) and in assignments (approx. 70% of turnover). New knowledge, processes and technology deriving from the research carried out are transferred to NLR stakeholders in various ways, including contract research, public-private partnerships and publications. The processes for transferring knowledge to our stakeholders and creating impact by valorising what we know can be strengthened. As recommended in the EMTO evaluation, we will therefore develop a valorisation strategy to improve the process and the methods further for transferring our knowledge and technology. This could for example involve developing the MITC further as a campus where knowledge-intensive and capital-intensive start-ups, scale-ups, SMEs and governmental organisations are given the opportunity to base themselves (temporarily) at NLR in Marknesse, close to our research infrastructure and expertise. This is how we can facilitate the transfer of knowledge and technology, letting these organisations play their optimum role in the technological leadership of the Netherlands and the strategic autonomy of Europe.

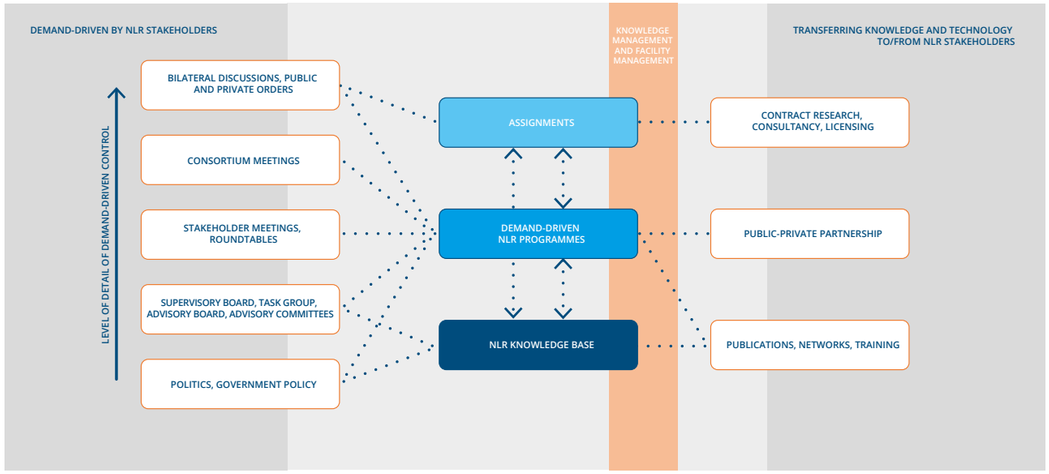


Figure 1 Relationship between demand-driven control, knowledge accumulation and transferring knowledge and technology at NLR

As part of that, we will look for ways of cooperating with other ecosystems and campuses in the Netherlands. We will continue to investigate whether we can also create room at NLR in Amsterdam to bring companies closer to our knowledge and facilities.

To give direction to the way knowledge develops, NLR has direct links and consultations with stakeholders at all levels of employment on a daily basis. These contacts are the basis of the demand-driven control and agreements about the research that NLR carries out. NLR distinguishes between various levels that demand-driven management takes place at, from political guidance and governmental policy at the highest level of abstraction down to bilateral discussions with project partners and clients as the most detailed form (see Figure 1). As part of the valorisation strategy that will be developed, we want to give stakeholders a clear understanding of our knowledge and how we develop it, as well as of the technologies that are available and under development. It is important here to emphasise our employees as being stakeholders of NLR and to highlight knowledge sharing within our growing organisation.

The NLR knowledge base is accumulated in research projects that are defined at NLR's initiative, in order to maintain and develop the knowledge required to answer future questions from industry, as well as policy questions. In line with the recommendation of the EMTO committee, NLR will maintain the breadth of its knowledge base to help ensure continued flexibility and adaptability when new trends and developments appear. NLR keeps its knowledge of typical aerospace disciplines up to date and actively looks for dual-use applications. More attention will also be paid to applying primarily civil-oriented knowledge in the military domain and vice versa. In line with the NTS [35] and the NLD areas defined by the Ministry of Defence [36], NLR is moreover building up knowledge in enabling disciplines such as data science, computer science, AI, quantum technology, high-power electrical systems and hydrogen technology. The knowledge in these disciplines and technological fields is geared primarily to applications in aerospace. Knowledge of psychology and educational science is also firmly embedded as a complement to our technological base.

In the demand-driven NLR programmes, knowledge is developed further in interdisciplinary and multidisciplinary projects involving collaboration between various fields of expertise. The NLR programmes provide a clear structure for the knowledge development that is required to realise our impact-oriented goals; they have been carefully set using Dutch public and private stakeholder roadmaps and visions. They are also evaluated periodically. The programme objectives, which are agreed with our stakeholders, set the direction for the research projects that we carry out. This programme-based way of working will be continued in this strategy period. As per the EMTO recommendation, NLR will focus explicitly on further streamlining and improving the process and improving the governance. Because the space domain is becoming increasingly important for Europe's strategic autonomy and because the Ministry of Defence is focusing on space technology as one of the five NLD areas [35], a new programme is being set up that specifically targets the space domain. We are thereby also arranging for further bolstering of our cooperation with the knowledge ecosystem of technical and non-technical universities, the Netherlands Defence Academy (NLDA), NWO institutes, universities of applied sciences and vocational education institutions that are relevant for developing knowledge about the use of the space domain. As a knowledge collective, we can work even more closely with the commercial ecosystem and our governments to achieve effective valorisation.

[4] *Political (national, regional, international), governmental (national, regional, international), businesses (start-ups, scale-ups, SME, large corporations, sector organisations), research organisations (TO2, educational institutions, NWO, international research organisations), society (general public, interest groups, environmental organisations)*

4.3 Research infrastructure

As explained in Chapter 2, NLR's research infrastructure plays a crucial role in the accumulation of knowledge and development of technology for the aerospace industry and in being capable of realising innovations faster. The NLR research plan drives the direction taken as our research infrastructure develops; it has been translated into a longer-term plan for facility development at NLR and DNW. We are increasingly looking to collaborate with other TO2 institutions and universities, as this will let us create synergy or establish links with other sectors.

One example of synergy creation is the TO2 Digi-lab, which has made good use of the expertise of all TO2 institutions to realise a virtual collaborative environment where researchers can work together in various configurations. Another example is the NLR battle lab, which allows complex multi-domain issues to be investigated realistically for the Ministry of Defence by linking our battle lab to those of the Ministry of Defence and other TO2 institutions.

An example of how we are forging links with other sectors to help develop sustainable mobility solutions with low carbon footprints is the development of the Automotive Test Section (ATS) in the DNW-LLF wind tunnel plus development of MITC as a knowledge and testing centre for smart mobility, where manned and autonomous vehicles and aircraft for the future are developed, tested and certified.

The heavier emphasis during this strategy period on a safe and resilient society has led NLR to focus its investments on defence research facilities too. Aligning with the NLD area 'space technology', NLR is investing in a Space Research Facility (SRF) with the aim of accelerating the development of space technology, providing a safe, low-regulation environment (sandbox) for testing new technologies and analysing future scenarios. We collaborate on this with the Ministry of Defence, TNO, Dutch companies and – where possible – the Netherlands Defence Academy (NLDA).

Our research infrastructure plays an essential role in the fast innovation lane too. Our facilities get used intensively and flexibly for testing whether new innovations work properly and to validate whether they also deliver the desired results. In addition, the users of these novel innovations need to familiarise themselves with them quickly if they are to be able to deploy them effectively.

NLR manages and commercially operates large research facilities that are unique in the Netherlands, and in a few cases even internationally. The course that the Netherlands and Europe have set for speeding up the boosting of economic strength, innovative capacity and strategic autonomy, reducing excessive dependencies and increasing security makes our facilities more strategically important than ever for the nation and for Europe. During this strategy period, we will structurally align our long-term plan for the NLR and DNW facilities in the national (TO2, universities and government) and European (Association of European Research Establishments in Aeronautics, EREA, and European Space Research Establishment, ESRE) contexts. Where possible, we will also collaborate to help speed up the development of facilities.

4.4 The approach to the market and the stakeholders

The external analysis in Chapter 2, combined with the chosen strategic direction as described in Chapter 3, determines the direction taken for approaching the market and our stakeholders. Our decision to focus expressly during this strategy period on the areas where those themes converge, with more emphasis on a safe and resilient society and on strengthening the competitive edge of the aerospace industry, provides context for the opportunities in our key markets: the Dutch and European ones. For that, our already strong market and stakeholder positioning must be continued and strengthened. In the approach to the market and stakeholders, extra attention must be paid to the goals set out in Chapter 3.

The government is a unique stakeholder, especially at a time when our social and economic security is under pressure. The Ministry of Defence demands that we are properly prepared and agile, so that we can scale up quickly when necessary. The emphasis is on accelerating innovation, with the aim of developing useful resources and deploying manpower effectively. Cooperating with governmental authorities, businesses, centres of expertise and educational institutions is essential for this. Working together is the only way to enable us to convert innovations – including disruptive ones – more quickly into concrete and deployable capabilities. Together with TNO and MARIN, NLR is increasingly being perceived by the Ministry of Defence as an extension of its own organisation for coordinating defence requirements with the market. We are being asked more and more to use our people to make a practical contribution when security situations require rapid scaling up. Not on the front line, but indeed by utilising our knowledge and expertise effectively to guarantee safety. This requires us to be faster, with greater flexibility, scalability and resilience, as well as working with our stakeholders in a way that suits that.

If this is to be achieved, the Dutch defence industrial base must be strengthened further. This involves building strong partnerships that target the needs of the Defence department and of security in general, within the broader context of a strategically autonomous Europe. We will work with both civilian and military industrial sectors to develop technologies in line with the NTS and NLD areas and integrate them into current and future capabilities.

Social issues in mobility, climate, infrastructure and energy all require a system-wide approach. Future European framework programmes will encourage research and innovation at that broad system level, rather than in specific sectors such as aviation. That is why we will reinforce cooperation with parties both inside the aviation sector and beyond, and help build a system-wide ecosystem, both nationally and internationally. By doing so, we want to let aviation play as big a part as possible in the smart, sustainable and resilient mobility system of the future. In terms of government bodies, this requires interaction with several ministries.

In the research domain, we will intensify our collaboration with other TO2 institutions, academic universities, universities of applied sciences, vocational colleges and the NWO. Together with the commercial sector, we will study how the aviation of the future – both manned and unmanned – can offer the right solutions within the broader mobility context. This gives us a targeted way of accumulating the requisite knowledge and developing value propositions.

As an independent research organisation with an independent position, we think having society and its citizens as major stakeholders is very valuable. Social media and discussion forums have given us direct access to the public and political debate, and journalism – as a representative of the traditional media – remains a source of verified news and background information. This combination gives us the opportunity to profile our brand image more and engage in current social issues, as well as to raise that profile even more emphatically through communications about NLR's expertise, our research results and the expected impact on society and the economy. For unbiased discussions within society, it is our role as an independent research organisation to provide factual, reliable and objective information to all parties in the public and political debate. Thanks to our expertise and our knowledge position, we are the ideal party for interpreting the effects of new developments and putting them in a broader perspective.

During the 2022–2025 strategy period, we increased our visibility in the social domain through our PR communication strategy. Continuing this approach means we can ensure that we effectively reach the various target groups through a targeted mix of communication resources and channels. When doing so, we respond to current events and share information about topics that may have an impact in the longer term.

4.5 Finances

To achieve our goals, we need a financial organisation that is robust in both the short and longer term. NLR's financial position is strong. During the previous strategy period, the scope of contract research (including long-term work) and the government's contribution increased. NLR's financial outlook for this strategy period is positive. The order book is at an extremely good level. Furthermore, we expect that safety, a competitive and innovative Dutch commercial sector and sustainability will continue to become more important and will offer opportunities for NLR.

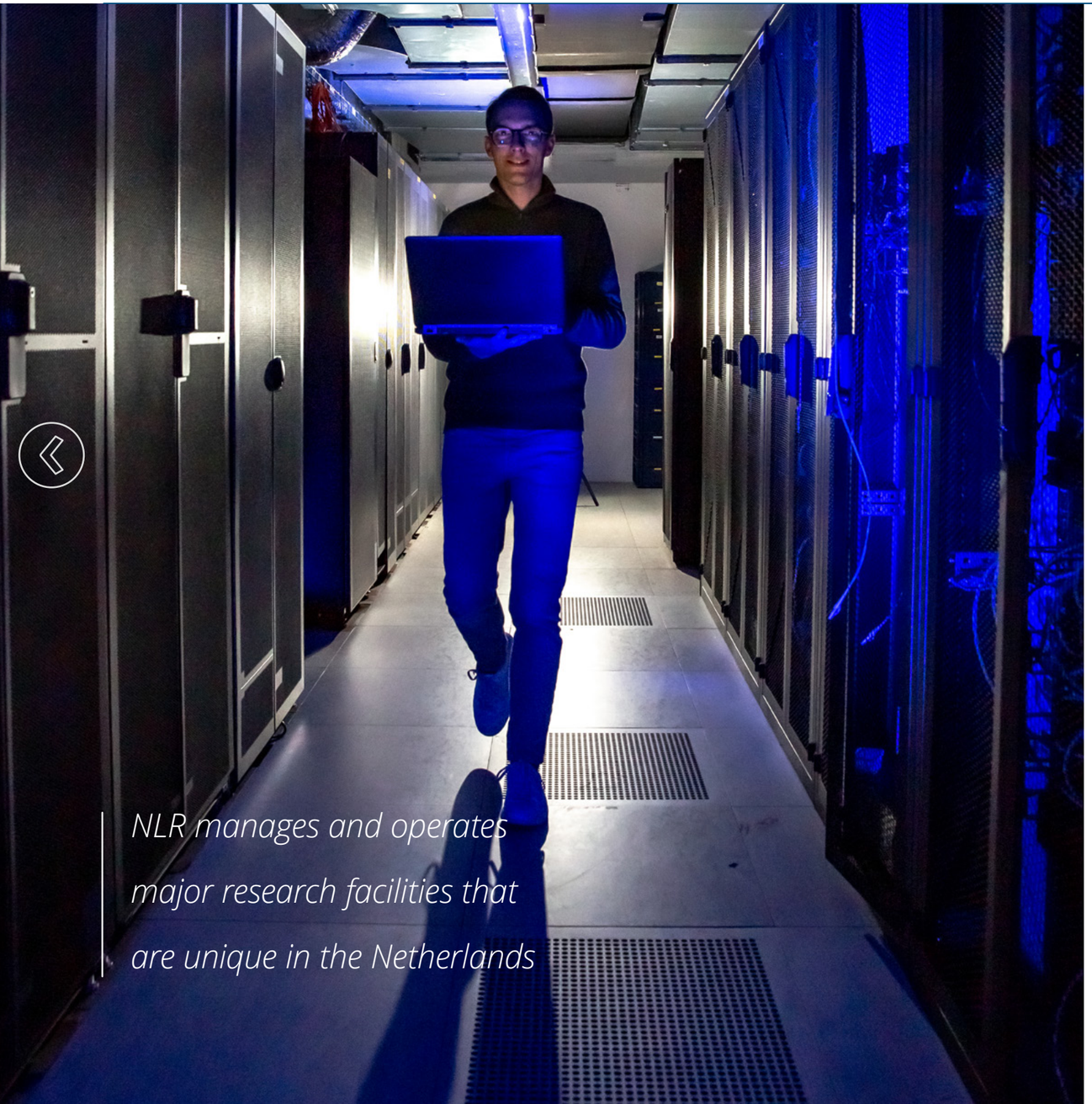
We do see a few points of concern in terms of managing our financial vitality, however. First and foremost, we must maintain a healthy balance between the civil and military research activities. Given the volatile security situation, though, and the uncertainties that entails, NLR will make sure it is ready to respond flexibly and scale up in the event of a change in priorities. Secondly, we want to keep a good balance between public and private clients, so that we avoid becoming too dependent on any one type of client and can continue to have an impact in the commercial sector. Thirdly, NLR's workforce grew substantially during the past strategy period. During this strategy period, we expect the number of staff to keep growing, by about 5 to 10 per cent per annum. Personnel planning for the newcomers and leavers over the next few years must always be aligned with a long-term estimate of demand for the services we provide. This is how we want to make sure that our turnover covers the workforce costs in the longer term. Moreover, as we have a growing workforce and defence-related research activities are increasing, we need to anticipate this in terms of our accommodation.

Finally, from a financial perspective, we will focus on keeping the knowledge level of our employees up to scratch. Although governmental funding increased during the previous strategy period, the number of employees in the research divisions increased even more sharply. If NLR is to remain relevant in the longer term, its employees must be given sufficient time and resources to devote to curiosity-driven research.

Because we expect the number of employees to keep growing, whereas the governmental contributions will not increase, our knowledge development will come under pressure. This is therefore an important point of concern during this period.

NLR's regular annual investment budget for renewing and maintaining the research infrastructure averages €9 million. NLR assesses the entire research infrastructure annually. Infrastructure that is no longer fulfilling a need for either the governmental bodies or the commercial sector in the Netherlands is divested. During the past strategy period, the Fighter-4 ship (a fixed-based simulator for four F-16s), the braiding machine and laser additive manufacturing unit from the Automated Composite Manufacturing (ACM) Pilot Plant were among the items therefore disposed of

In 2023, EZ allocated €9.7 million to NLR in the FTO funding round to boost the Smart Industry Fieldlab – Automated Composites and Metal Manufacturing & Maintenance (ACM3). For this type of major upgrade to facilities or for investments (of > €1 million) in new facilities, NLR is partly dependent on government funding arrangements. Unlike research funded by the governmental contribution to NLR, investments in large research infrastructure must be funded from NLR's own financial resources. As NLR is a non-profit foundation and operates (in principle) on a balanced budget, the possibilities for major upgrades and investments in particular are extremely limited. Examples include replacing the research aircraft (jointly with TU Delft) and a substantial investment needed for upgrading or replacing the high-speed wind tunnel (DNW-HST) so that military (European) platforms can continue to be tested in the future. Maintaining the quality of existing large-scale research infrastructure and setting up new facilities is in the national and European interest. As per the recommendation of the EMTO evaluation committee, NLR will work with the other TO2 institutions and the government to establish a structured system that will enable TO2 institutions to make such investments in large research infrastructure items.



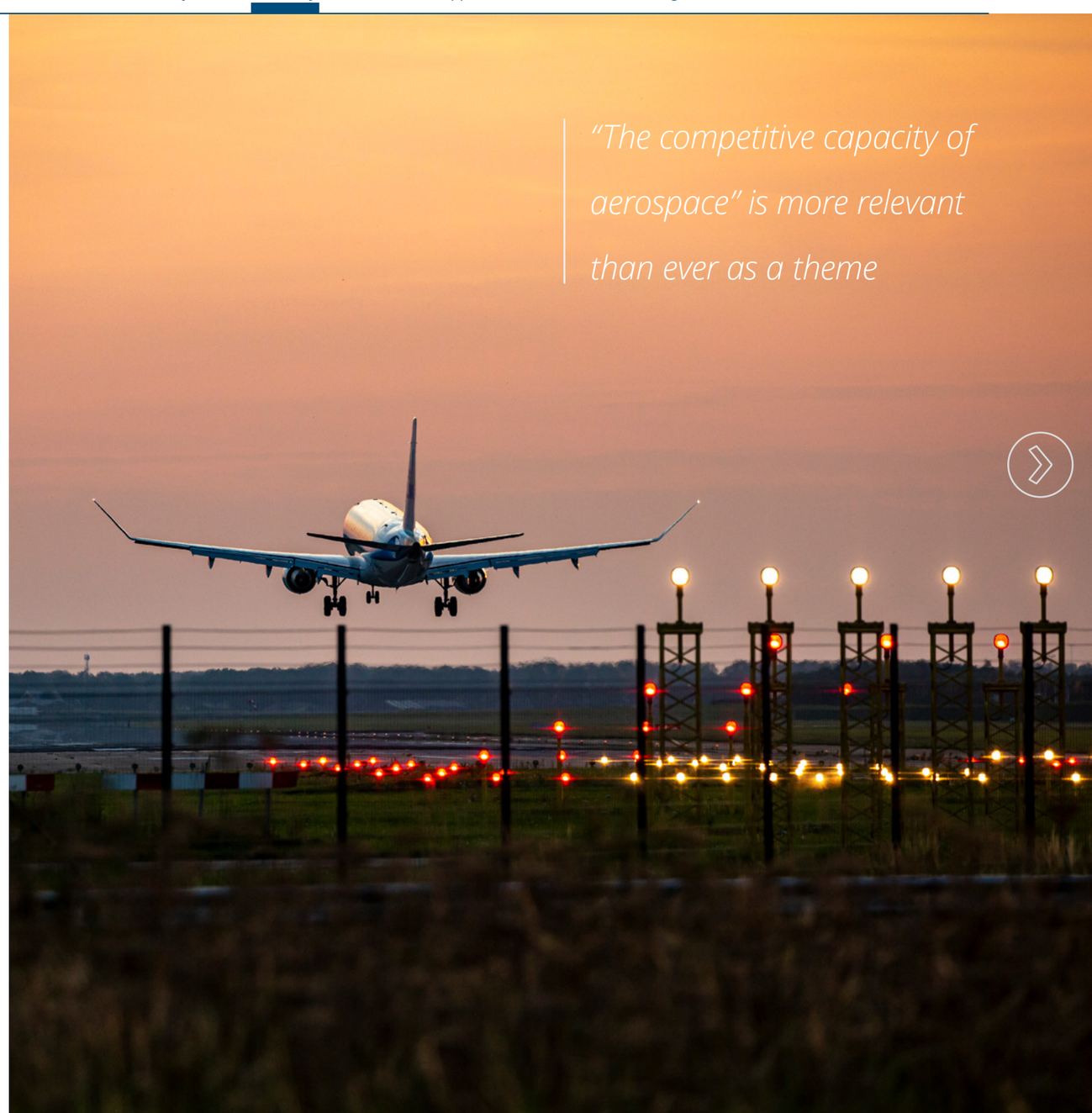
NLR manages and operates major research facilities that are unique in the Netherlands

Abbreviations and acronyms

Abbreviation/acronym	Description
ACM	Automated Composite Manufacturing
ACM3	Automated composites and metal manufacturing & maintenance
AI	Artificial intelligence
ATM	Air Traffic Management
ATS	Automotive Test Section
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CSRD	Corporate Sustainability Reporting Directive
CTO	Chief Technology Officer
DLT	Sustainable Aviation Roundtable *(Duurzame Luchtvaarttafel)*
D-SII	Defence Strategy for Industry and Innovation
EC	European Commission
ECB	European Central Bank
EDF	European Defence Fund
EMTO	Evaluation and Monitoring Framework for Applied Research *(Evaluatie en Monitoring van het Toegepast Onderzoek)*
EREA	Association of European Research Establishments in Aeronautics
ESA	European Space Agency
ESRE	European Space Research Establishments
ETS	Emissions Trading System
EU	European Union
EZ	Ministry of Economic Affairs *(ministerie van Economische Zaken)*
FTO	Applied Research Facilities *(Faciliteiten Toegepast Onderzoek)*
HR	Human Resource
HST	High-speed Tunnel
IMF	International Monetary Fund
LLF	Large Low-speed Facility
LTR	Long-term aerospace agenda *(Lange-termijn Ruimtevaartagenda)*
MeMo	Staff monitor *(Medewerkers Monitor)*
MITC	Mobility and Infrastructure Test Centre
NATO	North Atlantic Treaty Organization
NTS	National Technology Strategy
OEM	Original Equipment Manufacturer
QRDF	Quick Response Drone Facility
R&D	Research & development
RD&I	Research, development and innovation
SDG	Sustainable Development Goals
SESAR	Single European Sky ATM Research
SME	Small and medium-sized enterprises
TO2	Applied research organisations *(Toegepast Onderzoeksorganisaties)*
UN	United Nations
US	United States
VSME	Voluntary Reporting Standard for SMEs

Glossary

Term	Description
Call	The EU has drawn up rules for granting subsidies. Subsidies may for instance be possible through a call for proposals. Interested parties are thereby invited to submit a plan that is in line with the policy domain and the conditions set.
Disruption	A change or innovation that fundamentally alters or even replaces the existing market, industry or business model. Disruptive innovations are often radically new and offer a better solution to an existing problem than what was provided by the existing market.
Infrastructure	The physical and institutional facilities required to support activities and processes.
Climate-neutral	When the climate impact of all greenhouse gases and other effects not related to CO2 is balanced throughout the entire lifecycle of every component.
Multi-domain	An approach or system that covers several domains, disciplines or areas. In the Defence context, multi-domain refers to integration of several domains or areas to support military operations on land, at sea, in the air, in space and in the cyber environment.
Research and innovation ecosystem	A research and innovation ecosystem is an evolving network of stakeholders, activities (e.g. research, development, testing, evaluation and co-creation), resources (e.g. knowledge, technology, financial resources, human resources), policy frameworks, legislation and regulations, plus the collaborative relationships that matter for the success of innovation and value creation [49,50].
Scaling up	In the NLR context, this means increasing the capacity, production or services provided. More specifically, scaling up can mean: • Bringing in more staff or resources to realise projects; • Increasing the capacity for carrying out research and development; • Expanding services to more clients or sectors; • Speeding up the production processes for certain components or systems.
ReFuelEU	The ReFuelEU regulation is part of the EU's plan for a "green" transition (the FitFor55 package) and it aims to encourage production and use of sustainable aviation fuels.
Scale-up	A rapidly growing business with a validated business model. A scale-up is the successor to a start-up.
Start-up	A nascent, innovative, technology-driven company that is looking for a scalable and repeatable business model.
Stakeholders	All the individuals, groups or organisations that have an interest in various of NLR's activities or results, or statements made on behalf of NLR. We can distinguish here between stakeholders who are direct involved and those who are indirectly involved but nevertheless affected.
Value chain	A series of activities that organisations carry out to create value for their clients and other stakeholders. The value chain comprises all the steps needed for developing, producing and delivering a product or service to the client.



Sources

[1] "Generaal Eichelsheim roept op tot opschaling van productie binnen defensie-industrie", 30 november 2023, https://www.defensie.nl/actueel/nieuws/2023/11/30/generaal-eichelsheim-roept-op-tot-opschaling-van-productie-binnen-defensie-industrie

[2] Defensienota 2024 - Sterk, slim en samen, 5 september 2024, https://www.defensie.nl/downloads/beleidsnota-s/2024/09/05/defensienota-2024

[3] Niinistö, S. (2024). Safer Together - Strengthening Europe's Civilian and Military Preparedness and Readiness.

[4] Vanuit de ruimte, voor de aarde - Lange-termijn ruimtevaartagenda voor Nederland, 25 januari 2024, https://open.overheid.nl/documenten/e1e66e5e-b33e-417b-ac4b-1e040cfdb6d7/file

[5] Defensie Ruimte Agenda, 25 november 2022, https://www.defensie.nl/downloads/publicaties/2022/11/25/defensie-ruimte-agenda

[6] "NATO's Approach to Space", 21 maart 2024, https://www.nato.int/cps/eb/natohq/topics_175419.htm

[7] EU Space Strategy for Security and Defence, 18 maart 2024, https://defence-industry-space.ec.europa.eu/eu-space/eu-space-strategy-security-and-defence_en

[8] Draghi (2024). The future of European competitiveness Part A | A competitiveness strategy for Europe.

[9] Emissions Gap Report 2024, 24 oktober 2024, https://www.unep.org/resources/emissions-gap-report-2024.

[10] Heitor, M. (2024). Align, act, accelerate - Research, technology and innovation to boost European competitiveness.

[11] "Structureel € 5 miljard extra voor Defensie", 20 mei 2022, https://www.defensie.nl/actueel/nieuws/2022/05/20/structureel-5-miljard-extra-voor-defensie

[12] Defensienota 2022 - Sterker Nederland, veiliger Europa, 1 juni 2022, https://open.overheid.nl/documenten/ronl-66ca3fc1e21ea74ff78ec7bf3b478b3102d677f3/pdf

[13] "Nationaal Groeifonds investeert € 3,22 miljard extra in innovatie", 14 april 2022, https://www.rijksoverheid.nl/actueel/nieuws/2022/04/14/nationaal-groeifonds-investeert-322-miljard-euro-extra-in-innovatie

[14] ESA Space Environment Report 2024, 19 juli 2024, https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2024

[15] Kamerbrief met reactie kabinet op lange-termijn ruimtevaartagenda, 21 februari 2025, https://open.overheid.nl/documenten/2f2ce6fc-64db-47ad-b86e-7048be1681a9/file

[16] Nederlandse gedragscode wetenschappelijke integriteit, 1 oktober 2018, https://www.nwo.nl/nederlandse-gedragscode-wetenschappelijke-integriteit

[17] Evaluatieonderzoek organisaties voor toegepast onderzoek - Eindrapport deelevaluatie NLR, 4 februari 2025.

[18] Eurasia Group's top risks for 2024, 8 januari 2024, https://www.eurasiagroup.net/issues/top-risks-2024.

[19] Versterkte dreigingen in een wereld vol kunstmatige intelligentie - Een analyse van het effect van AI op de nationale veiligheid, 10 december 2024.

[20] EU defence in numbers, 28 februari 2025, https://www.consilium.europa.eu/nl/policies/defence-numbers/

[21] "Defensie werkt aan versterking van de krijgsmacht", 15 mei 2025, https://www.defensie.nl/actueel/nieuws/2024/05/15/defensie-werkt-aan-versterking-van-de-krijgsmacht

[22] Aerospace, Security and Defence Industries Association of Europe - Facts & figures 2024, https://umbraco.asd-europe.org/media/amoenldy/asd_facts-figures-2024_1119.pdf?rmode=pad&v=1db3a84f57bffc0

[23] "Commission unveils the White Paper for European Defence and the ReArm Europe Plan/Readiness 2030", 19 maart 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_793

[24] NATO's overarching Space Policy , 27 juni 2019, https://www.nato.int/cps/en/natohq/official_texts_190862.htm

[25] Defensie Strategie voor Industrie en Innovatie (D-SII 2025 - 2029)

[26] Voortgang Uitvoeringsagenda Innovatie & Onderzoek, Kamerbrief 23 mei 2024

[27] IMF - World Economic Outlook, oktober 2024, https://www.imf.org/en/Publications/WEO/Issues/2024/10/22/world-economic-outlook-october-2024

[28] World Bank Group - Global Economic Prospects, juni 2024, https://openknowledge.worldbank.org/server/api/core/bitstreams/d644659c-2e22-410e-98a5-b8a40dc6c183/content

[29] DNB - De stand van de Europese economie, 2024, https://www.dnb.nl/de-euro-en-europa/de-stand-van-de-europese-economie/

[30] "Demografie in het kort: Vergrijzing", 29 juni 2018, https://nidi.nl/demos/demografie-in-het-kort-vergrijzing/

[31] Global issues - population, https://www.un.org/en/global-issues/population

[32] A Competitiveness Compass for the EU, Brussels, 29.1.2025 COM(2025) 30 final.

[33] Innovatiebeleid, kamerstuk 33 009, nr. 117

[34] Industriebeleid, kamerstuk 29 826 nr. 147

[35] De Nationale Technologiestrategie, 19 januari 2024, https://open.overheid.nl/documenten/21220633-4dcf-4334-8f7c-c390eda7d29a/file

[36] Voortgang Uitvoeringsagenda Innovatie & Onderzoek, Kamerbrief 23 mei 2024.

[37] SEO december 2024 - Monitor ondernemingsklimaat 2024 - tweede meting en doorontwikkeling.

[38] "Buitenland lonkt naar Nederlandse start-ups, 'hier maar weinig durfinvesteerders'", 9 december 2024, https://nos.nl/artikel/2547725-buitenland-lonkt-naar-nederlandse-start-ups-hier-maar-weinig-durfinvesteerders

[39] Klimaatakkoord van Parijs, 12 december 2015, https://unfccc.int/process-and-meetings/the-paris-agreement.

[40] Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

[41] "Klimaatverandering vraagt om transformatie Defensie", 8 november 2024, https://magazines.defensie.nl/defensiekrant/2024/42/03_klimaatweek_42

[42] "Hoe wil de EU uiterlijk in 2050 een circulaire economie tot stand brengen?", 22 februari 2021, https://www.europarl.europa.eu/topics/nl/article/20210128STO96607/hoe-wil-de-eu-uiterlijk-in-2050-een-circulaire-economie-tot-stand-brengen

[43] "Nederland gaat leveringsrisico's kritieke grondstoffen beter in de gaten houden", 12 februari 2025, https://www.rijksoverheid.nl/actueel/nieuws/2025/02/12/nederland-gaat-leveringsrisicos-kritieke-grondstoffen-beter-in-de-gaten-houden

[44] Circularity requirements for vehicle design and management of end-of-life vehicles, december 2023. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/754627/EPRS_BRI(2023)754627_EN.pdf

[45] "Schone en duurzame mobiliteit", 14 februari 2025, https://www.consilium.europa.eu/nl/policies/clean-and-sustainable-mobility/

[46] ICAO - Resolution A41-21: Consolidated statement of continuing ICAO policies and practices related to environmental protection - Climate change. https://www.icao.int/environmental-protection/Documents/Assembly/Resolution_A41-21_Climate_change.pdf

[47] "Innoveren onder druk", 4 april 2025, https://magazines.defensie.nl/specials/2024/01/02_clsk-x_13

[48] Visie op het toegepaste onderzoek, 5 juli 2013, https://zoek.officielebekendmakingen.nl/blg-240097.pdf

[49] Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition. *Technovation, 90*, 102098.

[50] Vankan, A., Den Hertog, P., Jansen, M., De Boer, P. J., & Smeitink, A. (2020). Onderzoeks-en innovatie-ecosystemen in Nederland. Dialogic.

Appendix A Overview of NLR programmes

Appendix B Overview of NLR fields of knowledge and facility clusters

Fields of knowledge
Sustainability
Emissions
Noise
ATM & Airport Operations
Unmanned Operations
Safety
Human Performance
Human Autonomy Teaming
Training & Simulation
Flight Operations
Flight Test Operations
Future Force Design
Maintenance Engineering
Avionics Systems
Weapon Systems
Electronic Warfare
Military Operations
Electromagnetics Technology and Antennas
Environmental Qualification and Testing
Energy Management
Space Infrastructure and Operations
Space Information Utilisation
Space and C5ISR Information Sciences
Flight Test Support
Certification Support
Digital Flying Platforms Design and Multidisciplinary Analyses
Information & Software Engineering
Experimental Mechanics and Wind Tunnel Model Design
Materials Technology and Wind Tunnel Model Manufacturing
Computational Physics and Theoretical Aerodynamics
Aeroelasticity and Loads
Health Monitoring and Maintenance of Aircraft
Platform Integrity
Structures and Manufacturing Technology for Composites
Aerospace Materials
Non Destructive Testing
Aerospace Structures Testing
Vertical Flight Technology
Aeroacoustic and Experimental Aerodynamics
Metal Additive Manufacturing
Computational Mechanics

Facility clusters
Air Traffic System-simulators
Mission simulation facilities and *battle lab*
Laboratory aircraft
Aerospace Systems-facilities
Prototype manufacturing and test facilities
Aeronautical and engineering test facilities
Wind tunnels
Drone Center

NLR Amsterdam
Anthony Fokkerweg 2
1059 CM Amsterdam (NL)
+31 88 511 31 13

NLR Marknesse
Voorsterweg 31
8316 PR Marknesse (NL)
+31 88 511 44 44

ACKNOWLEDGEMENTS

Composition:
Katja Amelink
Michel Keuning
Martin Nagelsmit
Kees de Waal
Jeffrey Zitter

Design & production:
NLR Multimedia Groep

Photography:
NLR Multimedia
pag 12 © Ministerie van Defensie

info@nlr.nl www.nlr.org
May 2025