



**BOUNCING BACK
TO GROWTH**

ANNUAL REPORT 2018

TNO innovation
for life

TNO.NL

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KEY PROJECTS IN 2018

Throughout this report you will find text boxes containing the ten most high-profile projects undertaken by TNO during the year. Please visit the TNO website for further background information.

[Corporate Governance](#)

[Risk management and control system](#)

[Financial Statements 2018](#)

› BOARD OF MANAGEMENT



› BOARD OF MANAGEMENT IN 2018

FROM LEFT TO RIGHT:

- › CIS MARRING, CHIEF FINANCIAL OFFICER (CFO)
- › PAUL DE KROM, CHIEF EXECUTIVE OFFICER (CEO)
- › JOS KEURENTJES, CHIEF SCIENTIFIC OFFICER (CSO)
- › WIM NAGTEGAAL, CHIEF OPERATING OFFICER (COO)

REPORT OF THE BOARD OF MANAGEMENT

2018: BOUNCING BACK TO GROWTH

This has been a strong year for TNO overall. After years of retrenchment the trend has reversed, and the organisation has been channelling funds toward investment again. This has created more scope for addressing various challenges facing society and increasing the capacity for innovation of Dutch businesses. This is, in fact, much needed: innovation is crucial in order to tackle some of the major challenges of the twenty-first century, including climate change and security concerns. TNO began implementing the new strategy in 2018. The new organisational structure, comprised of nine market-focused and mission-focused Units, has been in place since 1 January 2018.

The recent surge in public and political support for applied research and innovation was evident in a variety of areas in 2017, including in that year's Coalition Agreement, which provides for an increase in investments in applied research. The amount in government funding TNO receives annually is rising incrementally and – from 2020 – it will be increased by EUR 34.8 million over the long term.

TNO and the ministries and other stakeholders concerned decided to invest the additional government funding in 11 programmes in 2018. Each of these programmes is aimed at resolving various major public issues and coincides with the priorities defined in the Coalition Agreement.

The Ministry of Defence is also directing additional resources toward TNO defence research. This is resulting in rapid growth and various hiring challenges. We made major progress in the past year in the joint development of knowledge and research for the Ministry of Justice and Security, law enforcement agencies and the National Coordinator for Security and Counterterrorism (*Nationaal Coördinator Terrorismebestrijding en Veiligheid/NCTV*). The Ministry of Social Affairs and Employment invested more in TNO research. The Ministry of Economic Affairs and Climate Policy and the North Holland Provincial Authority made funds available to be invested in a total of four ECN part of TNO labs in Petten, North Holland province.

TNO is delighted to have either entered into, or further strengthened, long-term partnerships with various government agencies.

In order to adapt to these changes, we continued to update our property portfolio in 2018. This includes completing major renovation and new development work at a number of sites currently used for defence research.

The transfer of the employees of the *De Rondom* site in Eindhoven and the renovation of the Helmond site are now completed. In addition, various new developments have been initiated related to real estate with the objective of further improving efficiency, the work environment, and harmony and integration with vital ecosystems.

IMPLEMENTATION OF NEW STRATEGY

TNO began implementing the new Flywheel of Innovation in the Netherlands (*Vlieg wiel voor innovatie in Nederland*) strategy in 2018. One of the main objectives of this strategy is the introduction of portfolio management in order to keep the research portfolio relevant and up to date. TNO's scientific capabilities have been enhanced for this purpose; this enables TNO to pursue a more proactive and targeted research strategy.

PUBLIC-PRIVATE PARTNERSHIPS

In line with the current strategy, TNO aims to further increase the number of large-scale, long-term partnerships over the next few years, including through what are known as 'Joint Innovation Centres'. These centres work closely with the business sector in conducting various types of research. All partnerships focus on the core of TNO's activities, namely making an impact through the application of innovative research developed by TNO. TNO's objective is to increase this impact.

TECHNOLOGY TRANSFER PROGRAMME

One important way in which TNO creates impact is by launching new companies and providing licences to existing ones. The Technology Transfer Programme, which was established for this purpose, was launched in 2017 and already began to pay off in 2018. The number of launched spinoff companies increased from five in 2017 to eight in 2018. Several companies have grown in size and have successfully completed one or more

funding rounds. This includes the TNO spinoff [SALDtech](#), a company that secured a loan in 2018 that will enable TNO to develop a machine that facilitates the new generation of flexible OLED displays (OLED = Organic Light Emitting Diodes, the leading smartphone display technology and an alternative to traditional LCD screens).

HIGH-PROFILE INNOVATIONS

TNO continued to develop various high-profile innovations in 2018. VDL Groep, for example, will be building the support structure for the main mirror of the world's largest telescope, located in northern Chile. 'The world's biggest eye on the sky' is roughly the size of a football stadium. This support structure was designed by TNO in association with VDL. This new development highlights TNO's position as a global leader in optical and optomechatronic systems for the aviation and astrophysics industries. We note that this is only one of several sub-fields in which TNO operates.

TNO has joined forces with Leiden University Medical Center (LUMC) in order to develop lifestyle medicine into a key component of curative care and has placed this item high on the social and political agendas. 'Lifestyle medicine' refers to the practice of curing diseases such as Type 2 diabetes and cardiovascular diseases through changes in lifestyle rather than through medication.

The Netherlands Innovation Centre for Lifestyle Medicine (NILG) was established in 2018, and the widely supported Manifest for Lifestyle Medicine was presented to the Minister of Medical Care, Bruno Bruins.

ENERGY INNOVATION

TNO has made a number of changes to its energy research programmes. The energy research conducted by ECN and TNO was consolidated in 2018 into a single, powerful research organisation that is set to accelerate the energy transition. Based on a series of eight innovation programmes, ECN part of TNO opened its doors in April 2018 as the new applied research centre for sustainable energy issues. The eight innovation programmes (roadmaps) are consistent with the energy agenda and the Coalition Agreement. Together with its partners and clients, ECN part of TNO seeks to contribute significantly to creating a carbon-efficient economy by 2050.

The Geological Survey of the Netherlands (*Geologische Dienst Nederland/GDN*) marked its centennial anniversary by presenting the latest geological map of the Kingdom of the Netherlands. In late 2018, a new centre for geothermics innovation dedicated to research was established. Energie Beheer Nederland, the Ministry of Economic Affairs and Climate Policy, the South Holland Provincial Authority, the City of Rijswijk and TNO were all involved in the creation of this centre of innovation, which is located in Rijswijk, South Holland province.

EXCELLENT EMPLOYER

To support its growth, the organisation began a large-scale and successful recruitment campaign in 2018. TNO is, and remains, an excellent employer: we were voted 'Best Company to Work For' in the technical industry for the sixth consecutive year in 2018. Our workforce increased by 12% (358 employees) over the past year.

FINANCIAL RESULTS

TNO posted non-consolidated earnings of EUR 4.9 million (excluding participating interests) in 2018. The consolidated earnings were dampened by the weak profits generated by participating interests due to reorganisation expenses and write-offs of assets. This resulted in a modest profit at the consolidated level. TNO intends to improve its financial results over the next few years.

CHANGES IN THE BOARD OF MANAGEMENT

Mr Nagtegaal (COO) and Mr Keurentjes (CSO) decided to part ways with TNO on completion of their term in January 2019. The members of the Supervisory Board and the Board of Management would again like to express their appreciation for these two gentlemen's commitment and contribution to TNO over the past five years.

Mr Tossings, formerly of the Ministry of Defence, will be taking on the position of Chief Operating Officer (COO) and Chair of the Council for Defence Research on the TNO Board of Management in March 2019. He will be succeeding Mr Nagtegaal in this role. Mr Tossings' initial dealings with TNO date from his time as a member of the Council for Defence Research during the period from 2012 to 2014, as a member of TNO's Strategic Defence Council for Defence & Security and as chair of the Nederland Radarland Steering Committee.

FINAL NOTE

The Board of Management would first like to thank all TNO customers and partners, both public and private, for the trust they have placed in our organisation. The Board is also proud of TNO's 3,265 employees, who help achieve TNO's mission every day with admirable passion, energy and drive. Our gratitude, of course, also goes out to the members of the Works Council. The Board of Management looks forward to continuing and strengthening all our partnerships in the coming year.

PROFILE, MISSION AND IMPACT

PROFILE

The Netherlands Organisation for Applied Scientific Research (TNO) was established under Dutch law in 1932. As an organisation established under public law, TNO holds an independent position. TNO's stated objective is to adapt research results so they can be used by companies and governments.

TNO's strategy is based on technological developments and trends in society. We work closely with our customers and partners in focusing on innovations in construction, infrastructure and the maritime industry, circular economy and the environment, defence and security, energy, healthy living, industry, information and communication technology, mobility and logistics, and strategic analysis and policy. These domains are in line with the challenges and goals of the Top Sectors designated by the Dutch government and with societal issues in the Netherlands and elsewhere in Europe.

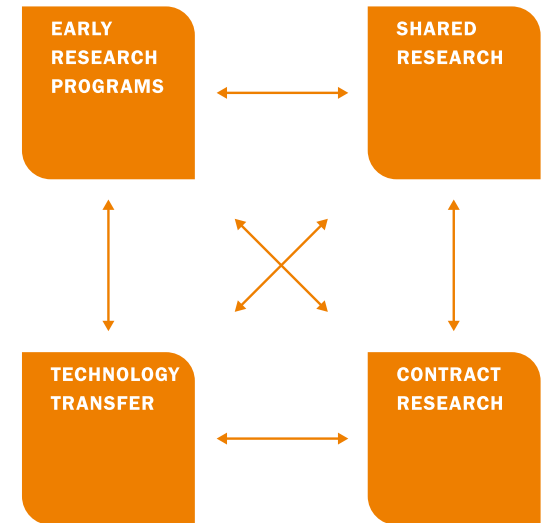
MISSION

TNO's mission is to connect people and knowledge with the objective of creating innovations that improve the competitive strength of businesses and public wellbeing in the long term. Based on this mission, TNO creates economic, social and societal impact in our partnerships with numerous companies and organisations in the Netherlands and abroad.

INNOVATION CYCLE: FOUR MAIN TYPES OF RESEARCH

TNO maintains four main forms of research, each of which has a different objective, is directed differently, is funded separately, and has a different legal structure:

- Early Research Programs (ERP)
- Shared Research (public-private and public-public partnerships), including Joint Innovation Centres (JICs)
- Contract Research
- Technology Transfer



The Early Research Programs serve to build knowledge and fundamentally update this knowledge. There are an average of ten of these types of large-scale research studies ongoing at any time. This type of research is most similar to the fundamental research conducted by universities, and the farthest removed from the market.

Research results are further developed in pre-competitive cooperation with public and private partners – this is referred to as 'Shared Research' and leads to numerous tangible innovations. TNO seeks to extend both the public-private and public-public partnerships in which it is involved.

Whenever requests we receive from customers and partners become more specific and there is a need for more personalised services, it is common for the follow-up research to no longer

be conducted in broad partnerships but to opt for contract research instead, the cost of which is fully covered by our customers. In doing so, TNO brings its research increasingly closer to the market.

Technology Transfer is the final stage in TNO's innovation cycle. During this stage, TNO takes its research results to the market in the form of licensing agreements, spinoffs and tangible innovation solutions.

TNO is able to create substantial value thanks to this system of four consecutive stages. You will find further information about our approach on [TNO.nl](https://www.tno.nl), along with information on the use of our IP portfolio and research programmes.

TNO's role as an innovator takes on a special form in its services for the Netherlands Ministries of Defence, Social Affairs and Employment, and Economic Affairs and Climate Policy. Knowledge-intensive government duties (statutory duties) related to defence and security, labour participation and the geological survey have all been delegated to TNO.

The purpose of the '[Innovation for Development](#)' programme is to implement various innovations in developing countries.

TNO'S FINANCIAL MODEL

TNO is a not-for-profit research organisation. It is important for business continuity that the expenses incurred by the organisation are covered and that (modest) returns are achieved for the purpose of investment, continuity in research development and a solid financial position.

The Early Research Programs and Shared Innovation programmes are always delivered at least in part with public funds. TNO's expenses incurred in these programmes are reimbursed. The expenses associated with non-governmental public programmes – including participation in the EU's Horizon 2020 programme – are only partially refunded.

In order to participate in these types of programmes, TNO must match these expenses with the resources provided as part of government funding. Financial results can only be achieved through contract research, spinoffs and through income arising from intellectual property rights.

The further development of research results for application in the market tends to be costly. Active management of the sharing of knowledge, value creation and valorisation management is necessary in order to ensure continuity of the organisation.

KEY PROJECT 2018

THE FUTURE OF PHOTOVOLTAIC CONCRETE FACADES

If we are to have an energy-neutral built environment in the Netherlands by 2050, it is essential to integrate solar energy into the living environment. While the production of sustainable energy is important, so are the scenery and the living environment. Within the Dutch Solar Design partnership, ECN part of TNO and several partners focus on combining solar energy generation, design and quality. [Read more.](#)

 ECN PART OF TNO



STRATEGY 2018-2021

GOAL

TNO launched a new [Strategic Plan](#) in 2018, the central focus of which is to increase the organisation's impact on the economy and society. In order to achieve this objective, TNO focuses on a number of *strategic objectives* and is developing a number of *strategic priorities*.

STRATEGIC OBJECTIVES

The purpose of the investments in the technological priorities defined in the Strategic Plan 2018-2021 is to achieve breakthroughs in research, partnership development, and valorisation. In 2018, this resulted in (planned) progression, innovation and transfer of Early Research Programs to demand-driven programmes and contract research.

The strategic objective *Nanotechnology and Quantum Technology* is making steady progress in terms of the stability and architecture of quantum computers and the internet, in the nanoscale detection of production errors on and below the surface of microprocessors, and in broadband long-distance optical satellite communications. In *Hybrid Energy Systems*, we made important progress in using solar energy to convert carbon into the fuels methane and formic acid. In addition, a new programme was launched focusing on the lifespan of solar cells. The programme aimed at Smart and Green Materials provided a breakthrough in temperature-independent infrared coatings. For *Smart Megastructures* an intelligent sensor and prediction system for maintenance was designed to optimise the safety, accessibility and cost of bridges. This is a topical issue in the Dutch infrastructure market.

New programmes are aimed at the strategic objective *Artificial Intelligence* (particularly verifiable, explainable and ethical AI/ Artificial Intelligence) and at the strategic objective *Media Synchronisation* (technology for social interactions in virtual and

augmented reality). The strategic objective *Robotics* delivered an initial demonstration in 2018 of a dual-hand telerobot for remote maintenance. The programme aimed at *Valorisation of Metadata* has resulted in a unique method for estimating the certainty or uncertainty involved in learning from Big Data.

The *Inside the Human Body* strategic objective has made key progress in the 'Organ on a Chip' programme (i.e. simulating human colon and liver physiology on a microchip for developing personalised applications of medications). In addition, a breakthrough was achieved in the 'Personalised Health' programme in terms of effective behavioural interventions based on systemic-biological models to reduce Type 2 diabetes, a lifestyle-related disease. The 'Exposense' programme took initial steps involving biological models and optical gas sensors for determining the human exposome (i.e. exposure to environmental factors). A new programme was launched around the strategic objective *Inside the Human Mind*, aimed at body-brain interaction (including the detection of a correlation between cognitive decline and obesity).

Finally, focusing on the strategic objective *Modelling and Predicting Social Systems*, two new programmes were launched, aimed at 'Wise policymaking' (i.e. modelling complexity for the purpose of bias-free human objectives and decision-making) and 'Innovation Outlook' (i.e. data-driven forecasting of technology development and its social and economic impact).

STRATEGIC PRIORITIES

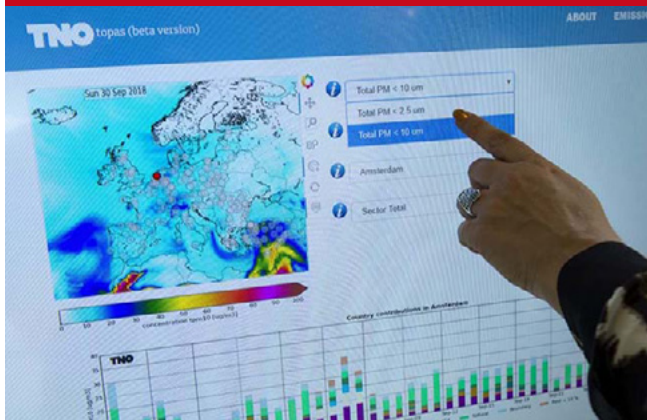
TNO has been working on further developing the organisation ahead of the next several years. The main results of 2018 are summarised below.

KEY PROJECT 2018

PINPOINT-ACCURATE DATA SHOWS ORIGIN OF PARTICULATE MATTER

Particulate matter is damaging to health, leading to respiratory diseases, cardiovascular diseases and premature death. There is an urgent need for reliable data on the origin of particulate matter. TNO's TOPAS web application provides policymakers and other stakeholders free of charge with data on the origin of particulate matter in more than 200 European cities, plus information on the source responsible. [Read more.](#)

 CIRCULAR ECONOMY & ENVIRONMENT



Continuous development and innovation of the research portfolio

ECN-TNO integration

On 1 April 2018, TNO's energy research operations and the Energy Research Centre of the Netherlands (*Energieonderzoekscentrum Nederland/ECN*) were consolidated into the new Unit ECN part of TNO. The integration into TNO resulted in the transfer of 306 FTEs overall (336 employees) to TNO.

The related research facilities were also acquired, at the carrying amount. The processing of the working capital and goodwill are further detailed in the financial statements. The consolidation has given rise to a leading international research centre with more than 700 employees. This puts this Unit in an excellent position to make a fundamental contribution to the energy transition the Netherlands will be undergoing.

Transfer of Functional Ingredients to WUR

TNO employees of the Functional Ingredients expertise group were transferred to Wageningen University on 1 January 2018. The transition to WUR resulted in the transfer of 38 FTEs (41 employees) from TNO. Furthermore, the related research facilities were acquired at the carrying amount. The fact that TNO will be focusing mainly on health in the future does not alter the fact that nutrition is and will remain a key determinant of health. Both organisations have therefore agreed to continue their partnership going forward.

Investing resources under the Coalition Agreement

The Coalition Agreement of the Third Rutte Cabinet provides that additional resources will be directed toward applied research. The government made an additional EUR 19 million available to TNO in early 2018, for which TNO has established the following socially and economically relevant programmes:

- Accelerated Sustainability of the Built Environment
- Circular Economy
- Industrial Electrification, Storage and Reuse of Carbon Dioxide
- Improving Sustainability of the Energy Supply (System Integration and Hydroxide)
- Smart Industry (Smart and Safe Workplaces)
- Integrated Photonics
- Artificial Intelligence
- Safe and Fair Society
- Radar and Sensor Systems
- Health and Prevention
- Sustainable and Smart Mobility and Infrastructure

In July 2018, the government decided that the innovation policy would be mission-driven starting in 2020.

The purpose of the innovation policy is to create innovative and economically high-potential projects which contribute to a safer, healthier and more sustainable society. Technological breakthroughs are vital when it comes to addressing societal challenges. Key technologies such as photonics, IT and artificial intelligence and nanotechnology, and quantum technology and biotechnology all play a key role in this regard.

Portfolio management method implemented

In order to focus more adequately on TNO's portfolio, making informed decisions in terms of what is and is not done to determine whether the portfolio is developing at the pace required, the implementation of a method for portfolio management was launched.

Knowledge Position Audits

Maintaining an excellent research position is crucial for TNO. Regular Knowledge Position Audits (*KennisPositieAudits/KPAs*) are conducted for this purpose. The KPA of the Construction,

) Infrastructure & Maritime Unit was conducted by an external audit committee in 2018.

The Committee was impressed by the quality of the documentation received and the professional approach.

There was also a great deal of appreciation for the high-quality expertise, enthusiasm for the field, and the drive of employees in terms of applying their expertise to create relevant solutions.

The Evaluation Committee was comprised of the following members: Professor Bert Geerken (Chairman, TU Delft), Professor Jørgen Amdahl, PhD MSc (NTNU), Professor Jürgen Schnell (University of Kaiserslautern), Professor Laure Itard (TU Delft) and David Manley, MSc, C. Eng (UK Ministry of Defence).

Spinoffs and spinouts in 2018

The Technology Transfer Programme resulted in seven spinoffs and one spinout in 2018. In addition, a total of 27 licences were issued TNO wide.

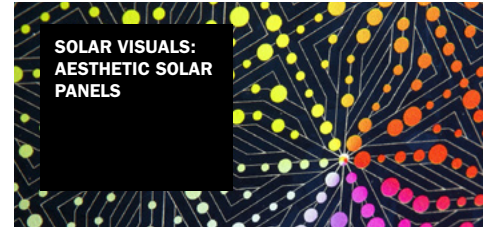


MorePV is developing an extension for solar panels that will enable a higher level of efficiency and a more aesthetically appealing look. The design of the popular 'all-black' panels will be enhanced by using a special technique that will really give them an all-over black hue. Combined with the higher level of efficiency, this will increase their appeal to the rapidly growing consumer market. Of course, a growing demand for these panels also helps accelerate the energy transition.



DNS Ninja is a cyber-security solution that protects financial institutions from intruders. The application is equipped to detect and ward off worldwide ransomware attacks such as WannaCry in the network immediately. Integrated algorithms instantly detect any irregularities in data traffic. DNS Ninja is easy to integrate into existing IT systems and infrastructures.

[Additional information about Sightlabs](#)



Standard roof-mounted solar panels will make way for photovoltaic (PV) modules of all imaginable types, formats and colours. The modules can even be integrated into a facade invisibly. After years of research and testing, ECN part of TNO and private-sector partners have developed a product that is both ready for the market and unique in the world. Large surfaces such as the walls of large office buildings can now be made energy-efficient in a visually appealing way.

[Additional information about Solar Visuals](#)



TrustTester is the key to online privacy and new types of digital services. Information is certified for commercial transactions without actually providing or storing data – that is the added value of TrustTester. This service combines a patented algorithm with a set of agreements. TrustTester validates information provided online, and the recipient organisation then knows that this is accurate. This helps to avoid costly and time-consuming control processes.

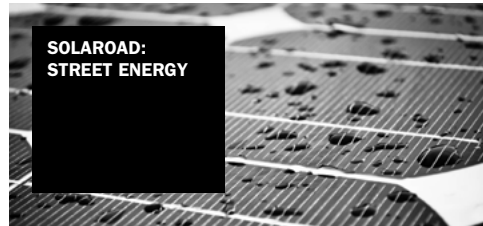
[Additional information about TrustTester](#)



Manufacturers worldwide are excited about a revolutionary new invention: a technology to manufacture the new generation of OLED displays for TVs, tablets and smartphones. They have far higher resolutions, brighter colours, a larger size, and are flexible. The Spatial Atomic Layer Disposition technology makes them efficient to produce. SALDtech is looking to establish a domestic industry to manufacture the complex machines.

[See page 4](#)

[Additional information SALDtech](#)



A road surface that captures sunlight and converts it into electricity: the SolaRoad technology is currently used in various locations in the Netherlands and France, and there has also been demand from California. It all started with a bike lane, and the next step is to use it on roads with heavy traffic. SolaRoad is a solution for the large-scale and invisible generation of solar energy, without the need for additional space.

[Additional information about SolaRoad](#)



Many buildings do not fully comply with the strict fire safety requirements. TBQ, drawing on research conducted by TNO, developed the Brandcheck inspection tool to be able to demonstrate that adequate fire safety measures are in place. This enables healthcare institutions to demonstrate to regulators that the measures they have implemented adequately guarantee safety. The tool will be adapted for other sectors in the immediate future, including schools, hotels and student accommodation. There is already a keen interest from abroad in the tool.

[Additional information about TBQ](#)



The security software spinout, including employees, was transferred to the joint venture Gexcon Netherlands BV in 2018. TNO holds a minority stake in this entity, which is managed by Norwegian-based Gexcom AS, which is marketing the TNO software on an exclusive basis. TNO has been developing security software for the oil and gas industry for many years. This enables companies to calculate and analyse the impact of various scenarios in order to reduce risk.

[Additional information about Gexcon Netherlands](#)

Improved cooperation

TNO strengthened its relationships with many of its partners, as well as launching several new partnerships. In Nijmegen, the organisation made major progress in the development of an innovation centre for a new generation of microchips. At this Chips Integration Technology Center (CITC), TNO will be working with companies NXP, Ampleon and Nexperia, as well as with Radboud University, Delft University of Technology, Arnhem University of Applied Sciences and Nijmegen University of Applied Sciences.

TNO, Sitech Services, Maastricht University and Brightlands Chemelot Campus signed a Letter of Intent for the establishment of a centre promoting the sustainability of the European processing industry. The creation of this centre will boost the development and application of technologies that will enable the European processing industry to achieve its sustainability and safety objectives.

Strengthening our international positioning

TNO aims to contribute to further developing the Netherlands as a global knowledge hub. TNO seeks to further strengthen its international position in view of the continued globalisation of research. This will contribute to transforming TNO into a truly international organisation, expressed, among other things, by a larger percentage of international employees and the fit-for-purpose use of English as the language of communication.

TNO is already successfully operating outside the Netherlands. Including EU calls, TNO revenue generated abroad will total EUR 94 million for 2018. EU research projects are an essential addition to our domestic research and innovation programmes. This is because cooperation with other European organisations and companies delivers the exchange of knowledge necessary to also make an impact and achieve excellence at an international level. TNO will be focused mainly on strengthening strategic

partnerships with peer institutions across Europe. An obvious choice of partner in this regard is the German-based research institution Fraunhofer, due to Germany's significance to the Netherlands as an industrial and trading partner.

TNO is also exploring opportunities for working together – or working more closely together – with organisations such as VITO in Belgium, Finland-based VTT, the Norwegian research organisation SINTEF, Spain's Tecnalia, and Rise in Sweden.

In some cases, TNO may decide to open an international branch, for example if this is a condition for entering into long-term partnerships. After receiving major orders from several large Japanese partners specialising in mobility, the organisation decided in August 2018 to open a sales office in New Yokohama, Japan. Following the transfer of Stichting ECN's renewable energy business to TNO, ECN's Chinese sales office in Beijing was transferred to TNO. This sales office, which specialises in sustainable energy and mobility, was established in 2013 with the objective of applying ECN research. The initial focus was on improving photovoltaic production processes, but its scope has since been extended to include biomass production and air quality measurement. The Qatar sales office closed down in 2018. It also proved to be difficult to carry out the research activities at the Singapore and Aruba branch offices on a cost-neutral basis. In late 2018, the organisation decided in principle to close down the Aruba branch office and to make alternative arrangements for the Singapore branch office. Current agreements and obligations relating to programmes and projects will, needless to say, continue to be complied with.

TNO continues to perform well under the current Horizon 2020 framework programme, with a relatively high likelihood of success. TNO's strategy for the Digital Innovation Hubs has attracted its share of interest.

KEY PROJECT 2018

TNO D-SCORE CAN MONITOR MENTAL DEVELOPMENT

Many children around the world are still lagging behind in their first five years of life, due to poor nutrition, insufficient care, and too few learning opportunities. This is estimated to affect more than four out of every ten children. To get a clear picture of this problem, TNO has developed a special screening method for measuring the Development Score (D-score) of young children.

[Read more.](#)



HEALTHY LIVING



In other news, the various European Member States will be working more closely together on defence research. TNO was one of the driving forces behind the establishment of the European Defence Fund.

Organisation & culture: external focus & adaptive

Implementation of new organisational structure

TNO formally implemented a new organisational model on 1 January 2018. It has abandoned the old matrix model, one of the reasons being to reduce complexity. This has been replaced with a market-focused and effective Unit Organisation. TNO is currently comprised of nine Units and a joint Services Organisation.

Improving account management

TNO is looking to further strengthen its relationships with its partners and customers. There is a clear role for account management in the new Unit organisation, with one of the Units assuming a coordinating role. The objective is to establish a single desk for partners and customers that is efficient, effective and customer-focused. TNO assesses its relationships with its customers through customer satisfaction audits.

It is important for TNO to learn more about customer experience as a basis for targeted improvement measures for project management.

- The overall customer satisfaction score for projects carried out by TNO in 2018 was the highest ever recorded: 4.39 on a 5-point scale (versus 4.32 in 2017).
- TNO scores 4.66 on a 5-point scale on knowledge and expertise (2017: 4.63).
- No customer complaints were filed in 2018 under the external complaints policy.

TNO's customers greatly value the organisation's knowledge and expertise and feel that TNO excels in understanding their objectives during project management (i.e. empathy). This results in a high-quality end product that is suitable for practical application.

One of our goals for 2019 is to further reduce turnaround times and increase the frequency of communications.

Sound financial management

Competent financial management is essential to ensuring TNO's continuity. The organisation must generate earnings to offset any financial setbacks, ensure the continuity of its business operations, and in order to continue investing in innovating its knowledge base and portfolio. A programme was launched in 2018 to further improve our financial results.

The increase in the government funding received from the Netherlands Ministry of Economic Affairs and Climate Policy (as evidenced by the State Budget and the 2019 decree) will help generate more revenue, which in turn results in an increased workforce. In addition to regular investments equivalent to the write-offs, the research facilities at the Petten site will be extended in 2019. This investment will be fully subsidised by the Ministry of Economic Affairs and Climate Policy and the North Holland Provincial Authority.

The organisation is expected to make a modest profit, similar to previous years.

Creating a talent incubator

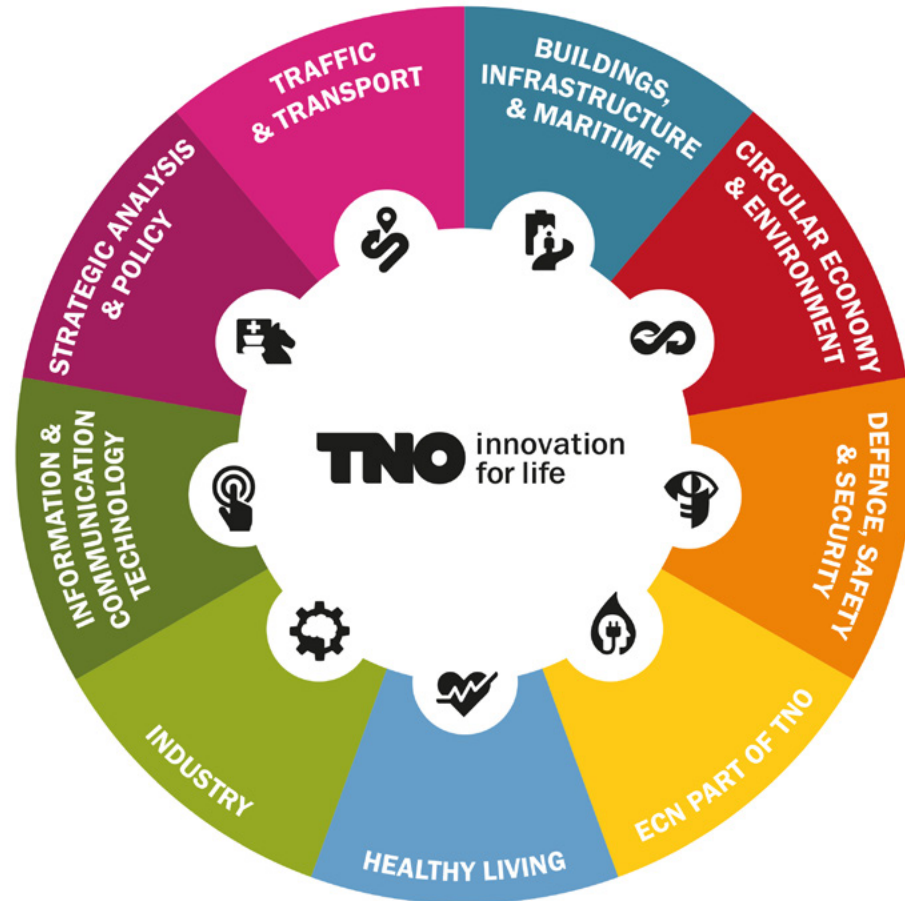
The new 'Grow in, Grow out' Human Capital Strategy was developed in 2017 in order to fulfil TNO's mission and objective, as defined in the Strategic Plan 2018-2021. TNO seeks to establish relationships with its employees based on equality, where the main objective is for each side to add value to the other. TNO strives to offer a challenging working and learning environment in which employees have maximum opportunities for personal development. TNO asks its people in return to dedicate themselves fully to fulfilling TNO's mission.

The Human Capital Strategy was implemented in the HR processes and tools at the TNO level in 2018. 'Grow in, Grow out' has been translated into a clear proposition for employees and prospective employees in the labour market. Next to mutual addition of value, the three central principles are: TNO focuses on talent, TNO facilitates (i.e. employees are in charge), and at TNO the work environment doubles as a learning environment. This clear-cut proposition enables TNO to attract and retain the right talent in a dynamic labour market.

TNO ORGANISATION

The nine Units making up the heart of the TNO organisation are shown in the chart on the right.

The Managing Directors of these Units report to the Board of Management. The latter, along with the Units, are supported by the Services Organisation. The Board of Management renders account to the Supervisory Board. The Council for Defence Research has specific powers and authorities provided under the law in relation to the Defence & Security Unit.



PERSONNEL

NUMBER OF EMPLOYEES

3,265 TOTAL WORKFORCE

2017

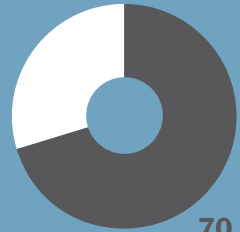


2,907

DIVERSITY

MALE-FEMALE RATIO TOTAL FOR TNO

29.7%



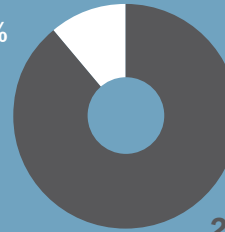
70.3%

Male
Female

OTHER

CONTRACTS

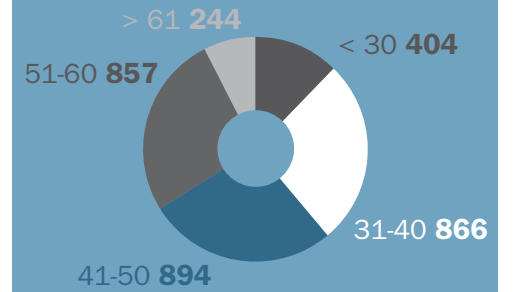
357
10.9%



2,908
89.1%

Permanent
Fixed-term

AGE COMPOSITION



SICKNESS ABSENCE

4.03% REPORTING FREQUENCY: 1.24

2017



3.61%

MALE-FEMALE RATIO - TNO SENIOR EXECUTIVES (SB, BoM & top)

40%



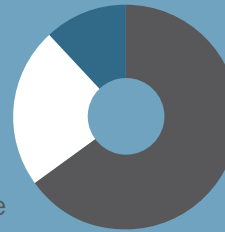
60%

Male
Female

FULL-TIME/PART-TIME

11.7%

23.1%



65.2%

Full-time
Part-time < 90%
Part-time 90% - 100%

EMPLOYEE ENGAGEMENT

7.2

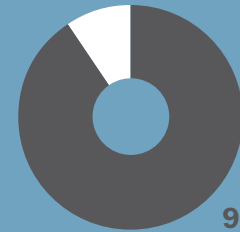
2017



7.1

NATIONALITY

9.3%



90.7%

Dutch
Non-Dutch

RECRUITING

(newly employed in 2018, excluding ECN)

389 FTE

INTERNSHIPS

STARTED IN 2018: 445

REPORT OF THE SUPERVISORY BOARD

The Supervisory Board includes seven members and is required under the TNO Act to monitor the policies set by the Board of Management, and to provide the latter with advice.

The Supervisory Board generally convenes at the various TNO sites, and in 2018, as in previous years during these visits, it had the opportunity to learn about the highly diverse and inspiring innovations and meet the passionate and highly skilled employees who continue to boost TNO's role with their enthusiasm.

TOPICS

The Supervisory Board was responsible in 2018 for maintaining overall supervision of TNO. Several important cases are highlighted below.

Organisation

TNO's new organisational structure was implemented in early 2018. The Supervisory Board's Selection and Remuneration Committee conducted talks with the Managing Directors of the nine new Units as part of their appointment process.

The new energy research centre was officially established (as part of TNO) on 1 April 2018. From this date, ECN's renewable energy business was consolidated with TNO's energy business in the ECN part of TNO Unit. The Supervisory Board was closely involved in the final agreements regarding this new partnership.

Update of Organisational Regulations

TNO's Organisational Regulations have been fully updated as a result of the above-mentioned organisational change. The terminology used under the TNO Act was applied to the current organisation. To the extent applicable, the Dutch Corporate Governance Code was complied with in drafting these regulations, along with the Basic Standards for Ethics in Public Administration, the Code of Scientific Practice, the Public Administration Code and the Shared Framework of Standards for Financial Management. The Supervisory Board approved or ratified the several sections of the new Organisational Regulations in March, followed by the implementation of the new regulations on 1 April 2018.

KEY PROJECT 2018

HOW DO UNDERWATER DRONES HELP DUTCH INDUSTRY?

Collaborating underwater drones provide excellent options for inspecting wind turbine farms and other offshore objects. This requires that they can communicate with each other underwater – this increases the efficiency and safety of offshore inspections and monitoring. TNO possesses the expertise and technology to use sound as an efficient communication device. This is expected to result in a breakthrough in the maritime sector. [Read more.](#)



DEFENCE, SAFETY & SECURITY



KEY PROJECT 2018

TNO IMPROVES INTERNATIONAL GREENHOUSE FOOD PRODUCTION

Ninety percent of the world's greenhouses are built and set up by Dutch companies. However, innovation is vital if our country is to retain this leading position. Companies specialising in greenhouse technology have therefore been focusing for years on research and development, a process in which TNO plays a key role. Dutch greenhouse manufacturers and horticultural technology companies are valued worldwide for their professional expertise and innovations. [Read more.](#)



**BUILDINGS, INFRASTRUCTURE
& MARITIME**



Internationalisation and branch offices

The Supervisory Board and Board of Management spoke on several occasions in the past year about TNO's internationalisation strategy, focusing specifically on attracting, and cooperating with, international researchers and organisations.

Other items on the agenda included the Aruba and Singapore branch offices. Both of these have been consistently onerous, and in December 2018 the organisation decided in principle to start downscaling the Aruba branch in 2019, followed by its closure at the end of this year. The organisation also decided in principle to discontinue the Singapore branch office in its current form.

Compliance

Another regular topic of conversation between the Supervisory Board and the Board of Management is TNO's compliance with various laws and regulations. In 2018, they focused specifically, for example, on compliance with the amended privacy laws and the stricter compliance with export controls.

Finance

The Supervisory Board approved the 2017 financial statements on 21 March 2018, followed by the 2019 budget on 12 December 2018. The new auditor, EY, will audit the financial statements starting in 2018.

Recruitment of new Board of Management members

The Chief Operating Officer, Mr Nagtegaal, and the Chief Scientific Officer, Mr Keurentjes both decided in 2018 to leave TNO on completion of their respective terms in early 2019. Mr Tossings, formerly of the Netherlands Ministry of Defence, will succeed Mr Nagtegaal as the new COO in March 2019. The recruitment of a new CSO is currently in the advanced stages and will be disclosed at a later date.

The Supervisory Board would like to express its appreciation for Mr Nagtegaal and Mr Keurentjes' great commitment and contribution to TNO over the past five years.

Performance of the Supervisory Board and evaluation of the Board of Management

The Supervisory Board held a 2-day offsite meeting in early 2018, in which the members – supervised by external experts – reviewed both the performance of the Board itself and its collaboration with the Board of Management.

In order to evaluate the Board of Management and its individual members, the Supervisory Board conducted the annual appraisal reviews with the Board of Management's chair and members.

MEMBERS OF THE SUPERVISORY BOARD AND ITS COMMITTEES

Professor J.M. Bensing (Ms) was honourably discharged as a member of the Supervisory Board effective 1 September 2018 following the end of her second term. She was succeeded by Professor H. Bijl (Ms), who was appointed by the Crown as a member of the Supervisory Board effective 1 September 2018. In addition, the Supervisory Board appointed Dr P.J.M. van Laarhoven as Deputy Chair effective 1 November 2018.

The three committees of the Supervisory Board were comprised of the members listed below in 2018.

Audit Committee

J.D. Lamse-Minderhoud (Chair)
I.G.C. Faber MBA
I.H.J. Vanden Berghe

Quality Committee

J.M. Bensing (Chair) – until 1 September 2018

P.P.C.C. Verbeek

H. Bijl – from 1 September 2018

Dr C.A. Linse

Selection and Remuneration Committee

P.J.M. van Laarhoven (Chair)

C.A. Linse

INDEPENDENCE

In the opinion of the Supervisory Board, the requirements for independence and impartiality pursuant to Articles 2.1.7-2.1.9 of the Dutch Corporate Governance Code 2016 were complied with.

MEETINGS

The Supervisory Board held five regular meetings in 2018, in addition to a strategic session and a 2-day offsite meeting.

The Audit Committee convened on three occasions, while the Selection and Remuneration Committee convened twice and the Quality Committee once.

The various committees also liaised with each other outside these meetings where necessary. The Chair of the Supervisory Board and one of the members attended two of the Works Council's meetings and also met regularly with representatives of the Ministry of Economic Affairs and Climate Policy.

ATTENDANCE

The attendance of the individual members of the Supervisory Board at the meetings of the Board and its committees in 2018 is shown in the table below.

	Supervisory Board meetings and gatherings	Committee meetings
Mr Linse	7 (of 7)	3 (of 3)
Mr Van Laarhoven	7 (of 7)	2 (of 2)
Ms Vanden Berghe	7 (of 7)	2 (of 3)
Ms Bensing (until 1/9)	4 (of 4)	1 (of 1)
Ms Bijl (from 1/9)	2 (of 3)	-
Ms Faber	6 (of 7)	3 (of 3)
Ms Lamse-Minderhoud	6 (of 7)	3 (of 3)
Mr Verbeek	6 (of 7)	1 (of 1)



Supervisory Board, from left to right: Jolanda Lamse-Minderhoud, Peter van Laarhoven (Deputy Chair), Hester Bijl, Aloys Maas (Secretary), Peter-Paul Verbeek, Kees Linse (Chair), Ingrid Vanden Berghe, Ingrid Faber.

REPORT OF THE COUNCIL FOR DEFENCE RESEARCH

The security environment is becoming more unstable, we are facing more – and more complex – threats, and Europe must be better equipped to protect itself. Closer to home, cyber attacks, organised crime, the vulnerability of the vital infrastructure and the Salisbury attack were cause for concern. Defence and security are therefore specific priorities of the Dutch government, which has directed additional funds for this purpose through the budgets of the ministries of Defence and Justice and Security and through the new innovation policy of the Ministry of Economic Affairs and Climate Policy. The publication of the new Defence Memorandum in 2018 marks the transition from an extended period of austerity to a new beginning with more investments in defence. A further increase in defence spending in the region of 2% of GDP (the target set within NATO) has been the subject of political debate. This growth outlook also has an impact on defence and security research, which is carried out in support of these plans. Knowledge and innovation are essential ingredients of this growth.

In our evolving world, the rapid advances in technology provide both opportunities and threats. The Council for Defence Research and TNO's Defence division are proactively focusing on the Agenda of the Ministries of Defence and Justice and Security. The new Defence Memorandum 'Investing in our People, Effectiveness and Visibility' (*Investeren in onze Mensen, Slagkracht en Zichtbaarheid*) was published in March 2018. This publication describes how the extra funds under the Coalition Agreement will be allocated, as well as providing a broad future outlook. In late 2018, the government, in its National Plan for NATO, expressed its intention to invest additional funds in defence. The plan outlines how the Netherlands intends to implement the decision of the NATO allies to increase their defence spending to 2% of their GDP. The current Defence Memorandum is scheduled to be reassessed in 2020. For knowledge and innovation, the Ministry of Defence previously defined some important building blocks in 2018, with input from TNO and other stakeholders. These were the extra resources included in the defence budget for specific applied research, the 'Accelerating Innovation Together' (*Samen Sneller Innoveren*) Defence Innovation Strategy and, in association with the Ministry of Economic Affairs and Climate Policy, the Defence Industry Strategy. The National Police is working on the basis of its Strategic Compass, 'The Future of Law Enforcement' (*De Politie van Overmorgen*), which provides guidelines for change and innovation. Knowledge and innovation (and cooperation with TNO) are essential parts of this plan. A Letter to Parliament titled 'Towards High-Impact, Mission-Driven Innovation Policy' (*Naar Missiegedreven Innovatiebeleid met Impact*) from the Ministry of Economic Affairs and Climate Policy, finally, brings together societal challenges and economic opportunities as part of a mission-driven approach, including – for the first time – a focus on security in the form of a separate item devoted to this issue. The missions for the issue of

Security, which should provide guidance for the applied research, were established in close cooperation between the Ministries of Defence and Justice and Security, and TNO.

GROWTH IN DEFENCE AND SECURITY RESEARCH

In view of the developments outlined above, TNO's Defence division initiated various changes in 2018 in its first year as the integrated Defence, Safety & Security Unit. One milestone was the completion of the major renovation and new development programme in The Hague Waalsdorp and Ypenburg. The latter celebrated the official opening, in September 2018, of a new multifunctional ballistic testing facility and a high-capacity laser system. The preparations for the construction of a new TNO research lab for protection against chemical and biological arms are currently underway. These construction activities illustrate the importance that the Council for Defence Research attaches to high-quality facilities as an essential condition for top research. New buildings must therefore be adapted to the increase in the number of new employees we have been seeing since 2018. This comes in the wake of the growing investments in defence and security research, for both knowledge accumulation and application of research. The Ministries of Defence and Justice and Security (including the National Police) are both moving forward swiftly with these initiatives. However, other domestic and international companies and governments placed orders as well. TNO is also taking additional measures to ensure compliance with regulations related to security and export control.

STRENGTHENING AND INNOVATION OF THE KNOWLEDGE BASE

The required strengthening and innovation of the defence knowledge base were energetically handled by TNO and the Ministry of Defence in 2018. The programme started in 2017 for risk-bearing analytical research and the innovation research impulses from the capital reserve generated significant results in areas ranging from autonomous systems, artificial intelligence

and quantum technology to laser weapons, meta-materials for protection and fighting hybrid threats. The investments under the 2018 Defence Memorandum were directed toward additional research related to cyber, information-driven performance and effectiveness, as well as toward new technologies such as artificial intelligence, robotics, 3D printing and biotechnology/nanotechnology. The Ministry of Justice and Security is investing in building a strategic knowledge base and launched several new target financing programmes. TNO's relationship with the National Police was further intensified in 2018 and culminated in a multi-year knowledge programme and an R&D process in order to achieve successful technology development and innovation. This covered areas such as law enforcement work in the cyber domain, operational effectiveness, the relationship between law enforcement agencies and society and the development of police professionals.

Additional funds provided by the Ministry of Economic Affairs and Climate Policy could be used to boost programmes for future radar technology and knowledge acquisition for law enforcement. This latter research programme, along with the first joint defence police programmes, symbolises the growing synergy through interdepartmental coordination.

The Council for Defence Research also welcomes the ongoing coordination across the national CB supply chain for protection against chemical and biological attacks and incidents. In addition to opportunities, this of course also provides a number of challenges.

INTERNATIONAL COOPERATION

The intensification of inter-governmental research cooperation entered a new stage in 2018 with the continuation of the groundbreaking SMART partnership with Norway relating to chemical, biological, radiological and nuclear (CBRN) protection. The Council for Defence Research also endorses the objective of the NATO Science & Technology Organisation to focus more

research efforts on significant areas such as autonomy and artificial intelligence & big data for military decision-making. TNO plays a guiding, coordinating role in this process, with and on behalf of the Netherlands Ministry of Defence (including through the creation of a roadmap). In a European context, TNO and the Ministries of Defence and Economic Affairs and Climate Policy further positioned themselves for the upcoming EDF programme for research and development related to defence. For example, a consortium with TNO won a European research project for high-power lasers. The bilateral partnership with Germany will continue to be intensively pursued; in the autumn, a project agreement was signed for shared and complementary research into territorial databases.

INSPIRING EVENTS AND INNOVATIVE PROJECTS

The seventh edition of the Innovation in Defence event attracted a record number of visitors. The JenV innovation conference and the Police Innovation conference also produced numerous examples of inspiring interaction between researchers and stakeholders. Furthermore, many innovative research programmes and high-impact projects were either initiated or continued, including:

- Underwater Wi-Fi with sound waves.
- 3D printing of energetic materials for munitions.
- The first-ever test of a quantum-safe VPN network.
- The serious game 'Influence', which offers a mix of psychology, gaming and operational planning.
- Software for analysis and prediction for investigative and intelligence work.
- A dynamic roadmap and resilience monitor for law enforcement officers.
- A modular framework for cooperation between autonomous systems, social AI modules, and people.

On behalf of the Council for Defence Research, Wim Nagtegaal, Chair until January 2019



Council for Defence Research, from left to right: H.G. (Henk) Geveke, A.P. (Auke) Venema, W. (Wim) Nagtegaal, Chair, M. (Marc) Gazenbeek, Deputy Chair, General Major E. (Eric) Schevenhoven and M.P.I. (Maarten) Manders, Secretary.

RISK MANAGEMENT AND CONTROL SYSTEM

RESPONSIBILITY

TNO's Board of Management is responsible for developing, implementing and monitoring TNO's internal risk management and control system. The purpose of this system is to ensure that the operational, quality and financial objectives are achieved, including by managing the risks associated with these objectives.

NATURE AND SCOPE

The internal risk management and control system is embedded into, and consequently forms an integral part of, TNO's organisational, management and governance model, as described elsewhere in this Annual Report (see the section on [Corporate Governance](#)). The system consists of a number of subsystems, the purpose of each of which is to reduce to an acceptable level the main risks associated with the strategic objectives and opportunities. These concern not only strategic risks, but also operational risks such as compliance with laws and regulations.

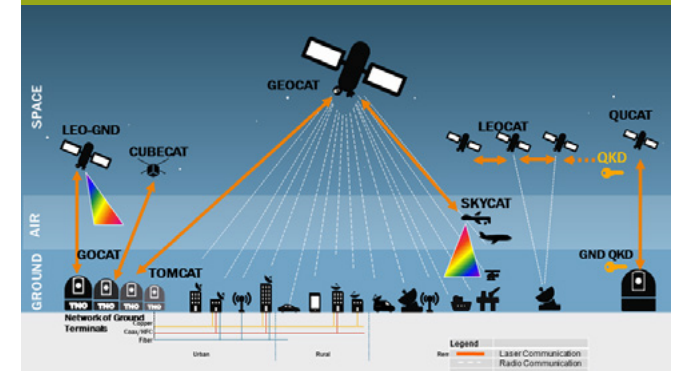
TNO's guiding principle in structuring its internal risk management and control system is the 'line of defence' model:

- First line: ensuring that the fundamentals are well organised by means of the controlled execution of the primary process by all TNO employees within the (internal and external) parameters set, aimed at achieving the objectives (including the strategic objectives).
- Second line: support in, and supervision of, the correct performance of these TNO activities.
- Third line: internal audits of TNO's (primary and secondary) processes from the point of view of quality, Health, Safety and the Environment (HSE), internal control (financial accounts), efficiency and other areas.

KEY PROJECT 2018

TNO DEVELOPS NEW STANDARD SATELLITE COMMUNICATIONS

Virtually all connections we use on a daily basis – including Wi-Fi, Bluetooth and 4G – are based on radio waves. However, the current technologies are about to be expanded with laser-satellite communications. TNO Nederland is working hard on developing this new form of optical communication, of which scientists have high expectations. Satellite-based optical systems make communication faster, more secure and more affordable. [Read more.](#)



- Fourth line: external audits conducted by third parties for financial aspects (by the external auditor), along with non-financial aspects, e.g. quality audits for ISO certification, knowledge position audits and inspections of compliance with permits and licences (e.g. Health, Safety and the Environment/ HSE).

STRUCTURE OF INTERNAL RISK MANAGEMENT AND CONTROL SYSTEM

The main elements of TNO's risk management and control system include:

- Culture and behaviour
- Duties, responsibilities and powers
- Planning & control cycle
- Risk management
- Physical and information security
- Audits

[The online appendix describes each of these elements in further detail.](#)

ACHIEVING RESPONSIBLE IMPACT

TNO always strives to present its results in a way that is as sustainable and responsible as possible by working closely with its stakeholders.

These stakeholder relationships are essential to TNO. Our organisation aspires to contribute to Responsible Research & Innovation (RRI). RRI is defined as taking into account impact on society, including the potential negative impact of new technologies and innovations.

This covers (among other things) the following keywords: Sustainability, Ethics & Integrity, and Social-Societal Coordination. TNO implemented the measures below in 2018.

SUSTAINABILITY

In addition to the TNO research activities designed primarily to create sustainability, TNO also focuses on the issues below in its business operations.

Improving the sustainability of buildings

Based on the EED legislation, the broad social and political discussion and other factors, TNO set the target in 2018 of being climate-neutral by 2030. As part of these efforts, TNO launched a comprehensive programme in 2018 for improving the sustainability of its buildings. This programme includes, among other things, a transition of the TNO buildings to climate-neutral, and a higher level of comfort through structural/architectural and installation measures. The potential measures were established for all buildings in 2018, which will be further developed and scheduled in 2019.

A trainee project was commissioned for this reason, in order to determine how, and under what conditions, TNO innovations can be used as a pilot project or showcase for the buildings. This provides a clearer picture of TNO's profile and added value and makes it instantly visible.

In order to support its transition to sustainable buildings, TNO is investing in sustainable energy generation of electricity (e.g. windmills and solar energy) and a natural-gas-free infrastructure (e.g. heat grid and thermal storage). As part of these efforts, TNO will take measures over the next few years relating to sustainable procurement. Through the tender for the new contract for electricity supply, which got underway in 2018, TNO intends to contribute directly to the climate targets set by the Dutch government. TNO's objective in signing this contract (for supply starting in 2020) is to use 100% of sustainably generated electricity, sourced from additional and traceable sustainable projects across the Netherlands.

Mobility

A number of measures have been implemented related to mobility, aimed at increasing sustainability. Examples of this include:

- Promoting the use of bicycles and e-bikes. The Bike to Work Scheme has been modified, so that employees receive a higher gross contribution when purchasing a bicycle or e-bike. In addition, e-bikes have been made available for travel between TNO sites located closely together.
- Improving videoconferencing facilities.
- Rolling out charging facilities for electric cars and bicycles in a variety of locations.
- Setting up a carpooling platform in October 2018 where employees can explore the need and opportunities for carpooling. An initial appeal resulted in 40 employees signing up.
- Exploration in The Hague, along with the national government, to set up a logistics hub to facilitate a significant reduction of logistics transport movements (i.e. fewer movements/more expensive implementation) for the Greater The Hague Area. A Letter of Intent was signed for this purpose in 2018.

ETHICS & INTEGRITY

Scientific integrity

A key focus for TNO in 2018 was the new Dutch Code for Scientific Integrity. TNO was involved in drafting this Code and has committed to signing and implementing the Code. Acceptance of this Code includes, among other things, that TNO will adapt its complaints procedures and that a publication policy will be drafted. TNO expects that its scientific integrity will be further strengthened through this Code and that it will facilitate cooperation with other scientific organisations.

KEY PROJECT 2018

SHARING DATA WITH NO PRIVACY RISKS?

How can you share sensitive data and information without potentially exposing it to unauthorised interceptors? Data protection is a hot-button issue: there is the new European privacy regulation (GDPR), for one, and hacked passwords are a leading cause of data breaches. Innovative and highly secure technologies that form the basis for secure multiparty computation have shown to open up all sorts of new avenues in this field. [Read more.](#)



INFORMATION & COMMUNICATION TECHNOLOGY



As part of the JERRI (Joint Efforts for Responsible Research and Innovation) European Horizon 2020 project, an integrity management game is being developed. This game was successfully played with our senior management in October 2018 and will be further implemented in the organisation. In addition, a tool has been developed to help people make ethical decisions regarding project organisation.

Human subject research and animal testing policy

A portion of the research conducted by TNO qualifies as human subject research. This includes research with research subjects, as well as research involving people-related data.

Some of this research is subject to the Medical Research Involving Human Subjects Act. For research involving human subjects not governed by this act, TNO has established a set of procedures to ensure that participant data is handled with care and to protect this data.

In addition, an organisation-wide internal Assessment Committee was established in spring 2018, which focuses on assessing all human subject research which is not subject to assessment under Dutch law. A total of more than 70 proposals were assessed in 2018.

TNO aspires to conduct excellent biomedical research, with the objective of improving human health. In some cases, this requires animal testing. TNO undertakes to conduct this research with as few animals as possible and causing minimal discomfort to the animals involved.

- A new policy memorandum on 'Test Animals and Animal Testing' was implemented in January 2018 (available on TNO.NL).
- Compliance with this memorandum is verified annually.
- The Animal Welfare Body (*Instantie voor Dierenwelzijn/IVD*) is the internal body responsible for monitoring animal welfare, the three Rs (Replacement, Reduction and Refinement of

animal testing) and the implementation of the Animal Testing Act.

- TNO is also a member of the Transition to Cruelty-Free Innovation (*Transitie Proefdiervrije Innovatie/TPI*) network, an initiative launched by the Ministry of Agriculture, Nature and Food Quality.
- Together with other parties, TNO conducts audits twice annually with critical suppliers in order to assess quality across the entire supply chain.

SOCIAL AND SOCIETAL COORDINATION

Sustainable Development Goals (SDGs)

TNO signed the Sustainable Development Goals Charter in 2017 and is a member of the SDG network of research and educational institutions established by the Ministry of Foreign Affairs. The SDGs form the basis for the methodology through which TNO intends to improve the transparency of its impact. The figure below shows the SDGs to which TNO contributes. An impact-mapping tool has been developed for TNO employees which enables them to identify the contribution of their project or programme to the SDGs. The tool promotes thinking based on social challenges. This tool will be rolled out across the organisation in 2019.



Open Access

TNO experienced substantial growth in the past few years through Open Access publication. A larger number of TNO publications are made available free of charge. This trend is endorsed by, among other things, Dutch and European financiers of scientific research in order to make results of research delivered with public funds publicly available. TNO supports its scientists in this initiative.

This year also marked the four-millionth publication request in the TNO Repository, a free online database containing TNO publications which was created three years ago. This demonstrates the broad relevance to society of sharing knowledge of all kinds with the public.

In addition, TNO has developed a new policy that promotes Open Access publication where possible. This shows employees which results will and will not be published. In making these decisions, TNO abides by the principle: 'Open where possible, closed if necessary'. This policy will be implemented in 2019. A number of international best practices have been exchanged in this area in association with the Fraunhofer Gesellschaft.

Diversity

TNO continued its efforts in 2018 to further improve the gender balance, international diversity and inclusive leadership. TNO's policy aims to strengthen the organisation and individuals alike. Two implicit bias training courses were held to teach participants to identify blind spots. We also hosted several training sessions and workshops on the subject of inclusion, as well as developing guidelines for neutral/gender-neutral recruitment and selection processes which were disseminated across the organisation. The success of these efforts is evidenced, among other things, within the Defence, Safety & Security Unit, where more than 45% of the 70 new hires in the past year have been female. The number of employees with nationalities other than Dutch is also growing.

The diversity targets, as included in the Strategic Plan, have been translated into concrete implementation plans. Our corporate intranet site, for example, has featured items on role models, which give these employees the opportunity to serve as examples and inspire their colleagues. The annual Employee Satisfaction Survey contained a section on inclusion (and the sense of inclusion) in order to ensure diversity. The results of the survey show that, in addition to the need to diversify its hiring practices, TNO must devote more attention to retaining a variety of talent. The survey shows, for example, that international employees are more likely to leave TNO, are less satisfied with their work, score higher on burnout-related complaints, and identify less closely with TNO than their Dutch counterparts.

Two Female Leadership programmes were launched for TNO employees, along with three workshops aimed at improving negotiation skills and power. In addition, informal networking meetings were held at a variety of TNO sites, where gender and international and intercultural diversity were central. In addition to direct improvements, this also generates input for the work performed by the Diversity Steering Committee.

KEY PROJECT 2018

TNO HELPS BUILD HOMES IN MALAWI

People in Malawi prefer to live in a stone house, so the demand for bricks is huge. In the traditional production of bricks, clamps and firewood are used. This leads to deforestation and high CO2 emissions. Moreover, the bricks produced are of poor quality and no less than 40% of the bricks are rejected during the building process. TNO has investigated the technical possibilities for making high-quality bricks from material from waste streams without heating. Local companies are eagerly looking for partnerships in this area.

[Read more.](#)



HEALTHY LIVING



KEY FINANCIAL DATA 2018

(in EUR million)	2018	2017	2016
TNO consolidated income			
Operating income	504.9	477.4	545.3
of which revenue	483.0	461.4	530.6
of which other operating income	21.9	16.0	14.8
Breakdown of revenue			
Market revenue	266.7	284.9	354.3
Government funding	216.3	176.5	176.3
Expenses			
Operating expenses	499.2	480.2	523.5
of which personnel expenses	312.9	301.4	320.6
of which impairment	-	-	-
Net profit	0.0	58.3	14.2
Cash flow for the financial year	55.6	40.2	14.2
Capital			
Invested business assets	285.1	281.1	241.0
Equity	249.6	249.6	191.3
Solvency	0.52	0.58	0.45
Assets			
Property, plant and equipment	181.2	177.4	181.8
Investments in property, plant and equipment	37.5	56.2	34.6

	2018	2017	2016
Employees			
Number of employees (FTEs – average) TNO	2,860	2,627	2,618
Number of employees (FTEs year-end) TNO	2,900	2,670	2,548
Number of employees (effective average) group companies	5	372	749
Number of employees (effective at year end) group companies	5	0	707
Number of FTEs (at year-end)	2,905	2,670	3,354
Average number of FTEs	2,865	2,999	3,438

FINANCIAL SUMMARY

TNO's non-consolidated earnings excluding participating interests totalled EUR 4.9 million. The allocation of the additional government funding in May 2018 led to increased production and revenue during the second half of the year, resulting in an underlying improvement of results. This was offset, however, by occasional charges in the form of ECN transaction fees, several weak project results and the write-off of an investment project.

In addition to operating income, the company incurred substantial losses through its participating interests in the amount of EUR 4.9 million, mainly as a result of an ongoing corporate reorganisation, as well as a write-off of real estate-related assets at two participating interests within the minority stake in First Dutch Innovations. This brought TNO's total earnings to EUR 39,000.

Effective 1 April 2018, the sustainable energy business of the Energy Research Centre of the Netherlands (ECN) was consolidated with TNO's energy research. This resulted in an increase in both revenue and operating expenses in relation to 2017, by approximately EUR 40 million. The Functional Ingredients research group had already been transferred to Wageningen Research effective 1 January 2018, causing revenue and expenses to decline by approximately EUR 7 million from 2017. The total financial effect of these transactions therefore came to around EUR 33 million in revenues and operating expenses. The nonrecurring expenses related to the ECN transactions came to around EUR 5 million, which dampened earnings for 2018. This includes an exit fee payable to ABP pension fund in the amount of EUR 2.6 million, relating to the pension transfer of ECN employees to the TNO pension fund.

The order intake for 2018 reached EUR 293 million, as projected. The transition to a new VAT regime effective 2016 (a portion of the withholding tax is no longer deductible for TNO) was offset by the Ministry of Economic Affairs and Climate Policy. In 2017 and 2018, investments in property, plant and equipment were above the level taken into account when determining this offset. The deficit on the offset is covered by government funding, which means there are fewer funds available for innovation.

NOTES TO THE CONSOLIDATED FINANCIAL STATEMENTS

Earnings

TNO posted a modest profit in 2018 of EUR 39,000. Profit for the comparative year 2017 was EUR 58.3 million, primarily as a result of the (nonrecurring) profit from the sale of a majority stake in TNO Bedrijven (currently trading as First Dutch Innovations). The profit for 2018 includes earnings from participating interests in the amount of EUR -4.9 million, as outlined above.

Revenue and expenses fell as a result of the deconsolidation of TNO Bedrijven and the transfer of Functional Ingredients. They increased as a result of the integration of ECN. The effect of these transactions on earnings is negligible, with the exception of the nonrecurring ECN expenses listed above.

NOTES TO THE COMPANY FINANCIAL STATEMENTS

Revenue

Company revenue increased from EUR 425.6 million in 2017 to 482.2 million in 2018. The increase was driven mainly by the integration of ECN's energy division effective 1 April 2018 and the additional government funding made available during 2018.

Each EUR 1.00 in revenue from government funding in 2018 was offset by an average of EUR 1.23 in market revenue (2017: EUR 1.41). This shifted ratio can be attributed primarily to the increase in investment in knowledge delivered through government funding, which has no immediate effect on market revenue.

Working stock

The total working stock is in order, but unevenly distributed among the Units and the research groups. As a result, reorganisations were implemented in various parts of the organisation.

Operating expenses

Wages costs, including pension charges and social security contributions, increased by EUR 31.3 million from 2017. A total of EUR 24 million of this increase is the result of the 1.5% salary increase in 2018, an increase in pension charges and other social security contributions, and an increase in average workforce numbers. The remaining personnel expenses increased by EUR 7.3 million, including a EUR 2.6 million exit fee paid to the ABP pension fund on behalf of ECN employees, a EUR 2.4 million increase in expenses for contract staff, and a EUR 0.9 million increase in expenses for movements in personnel provisions.

The other operating expenses increased by EUR 8.1 million from 2017. Rents and building expenses, energy expenses, expenses related to materials and equipment, general management expenses, outsourced activities and contributions paid increased by EUR 7.9 million, mainly due to the increased activity following the integration of ECN. Movements in provisions increased by EUR 2.9 million, due mainly to a provision for vacancy within the accommodation portfolio. This was offset by a EUR 2.7 million decrease in other expenses. In 2017, this concerned non-recoverable VAT for which no additional funding was available. In 2018, non-deductible VAT was covered by the government contribution.

Direct project expenses increased by EUR 12.6 million: from EUR 65.6 million in 2017 to EUR 78.2 million in 2018.

Direct project expenses include non-recoverable VAT (2018: EUR 22.8 million; 2017: EUR 17.2 million). Total write-down expenses increased by EUR 2.0 million between 2017 and 2018 (including a EUR 0.4 million ECN goodwill write-down), from EUR 17.2 million to EUR 19.2 million. Investments in 2018 totalled more than EUR 36 million – exceeding the write-down expenses for 2018 by approximately EUR 17 million. New buildings and renovation of two Defence & Security sites are the main reason for this high investment level.

Taxes

TNO and the Dutch Tax and Customs Administration (*Belastingdienst*) came to an agreement in 2019 regarding the application method used for corporation tax, which was introduced for semi-government agencies effective 2016. The parties agreed that TNO's full earnings would be taxed. The Tax item in the income statement for 2018 was EUR -1.5 million. This item breaks down as follows: the deferred tax asset was amended in 2018, resulting in an expense of EUR 1.0 million. Furthermore, a recalculation of 2017 figures resulted in additional revenues of EUR 0.1 million. Current tax charges for 2018 totalled EUR 0.6 million.

Equity

The special reserve for Defence fell by EUR 13.0 million in 2018: from EUR 30.6 million at year-end 2017 to EUR 17.6 million at year-end 2018. This concerns the balance of defence-related investments (EUR 16.1 million) and allocations to the special reserve (EUR 3.1 million). The general reserve increased accordingly.

KEY PROJECT 2018

FACTORY OF THE FUTURE FOR NEXT-GENERATION DISPLAYS

Monitor manufacturers were instantly excited when TNO experts recently demonstrated a revolutionary new invention: a technology for manufacturing the next generation of OLED displays for TVs, tablets and smartphones. This is a method for applying thin layers of functional materials on large-surface glass sheets. No other company had managed to achieve this up to this point. [Read more.](#)



The statutory reserve fell by EUR 8.4 million in 2018, to EUR 8.0 million at year-end 2018. The statutory reserve relates to non-payable profits of investments in the group companies. The changes outlined above, along with the modest profit of EUR 39,000, result in a EUR 21.4 million increase in the general reserve.

Cash and cash equivalents

The balance of cash and cash equivalents at year-end 2018 was EUR 161.1 million. This balance increased by EUR 65.8 million between year-end 2017 and 2018. This increase includes a number of special items, particularly the Accruals and deferred income item, as outlined below.

In 2018, investments in intangible assets and fixed assets exceeded write-downs by EUR 29.2 million. A total of EUR 8.1 million of this amount can be attributed to the impact of the acquisition of the business of ECN in 2018, while EUR 16.1 million is related to work on new buildings for the Defence Unit. A total of EUR 10.5 million was paid off on the Loans item in 2018.

Working capital increased by EUR 60.0 million in 2018, due mainly to the Accruals and deferred income item, which increased by EUR 50.1 million. This includes a total of EUR 31.6 million in investment funds which will result in an expense in 2019, along with EUR 11.0 million in project advances, which are to be transferred to third parties in 2019.

Positive cash flows relating to provisions amounted to EUR 5.1 million in 2018.

Disposals of, and book profits on, property, plant and equipment account for around EUR 15.2 million of movements in cash and cash equivalents. One of the TNO sites was sold in 2018 as part of efforts to reduce vacancy rates.

The loans drawn down as part of the Economic Affairs Future Fund, the repayments on loans received and the earnings account for a total of EUR 1.3 million of the increase in cash and cash equivalents.

Financial position

The organisation's cash position was high at year-end 2018 because TNO received a large amount in advance grant payments (EUR 36 million). These resources will be used after 2018 or will be transferred to consortium partners if TNO is acting as a coordinator. Once the item has been adjusted, the cash position will be deemed sufficient for conducting business operations.

Solvency increased from 2016 and fell slightly from 2017. This is also the result of the above-mentioned project advances, which will be settled in 2019. This is expected to result in an increase in solvency in 2019.

Workforce

The average number of FTEs increased by 233 FTEs (from 2,627 FTEs to 2,860 FTEs) between 2017 and 2018. This increase is due mainly to the transfer of the employees of the sustainable energy business of the Energy Research Centre of the Netherlands (ECN) to TNO.

KEY PROJECT 2018

TNO IMPROVES TRAFFIC SAFETY

Aircraft manufacturers, suppliers, research and educational institutions and the government are working towards making driverless vehicles a common everyday sight. TNO contributes to the safe introduction of driverless passenger cars and trucks in current traffic.

TNO is developing a method for optimally integrating driverless vehicles into today's traffic landscape.

[Read more.](#)



TRAFFIC & TRANSPORT



› APPENDICES

MEMBERS OF THE BOARD OF MANAGEMENT

PERSONAL DETAILS OF THE BOARD OF MANAGEMENT (2018)

P. de Krom, Chair/CEO (b. 1963)

In office since 1 March 2015

Management and supervisory positions

- Board member, Federation of Cooperating Organisations in Applied Research (TO2)
- Chairman of the Supervisory Board of HTM Beheer BV
- Member of the Supervisory Board of HTM Personenvervoer NV
- Director of Royal Holland Society of Sciences and Humanities
- Deputy Chairman of the Supervisory Board, Utrecht University of Applied Sciences
- Board member, Thorbecke Society for Representation and Democratic Governance
- Chairman, Thorbecke table, Sociëteit de Witte
- Member, South Holland Economic Board
- Chair of the Board, Holland International Distribution Council (HIDC)

W. Nagtegaal, COO, Vice-Admiral BD (b. 1957)

In office from 1 February 2014 to 13 January 2019

Management and supervisory positions

- Board member, Stichting Nederland Maritiem Land (NML)
- Board member, Stichting Nederlandse Industrie voor Defensie en Veiligheid (NIDV)
- Member, Executive Committee, Nederland Maritiem Cluster (NMC)
- Board Chairman, Stichting Maritiem Kenniscentrum (MKC)
- Supervisory Board member, First Dutch Innovations BV (FDI)
- Supervisory Board member, Vereniging Nederlandsch Historisch Scheepvaart Museum

F. Marring, CFO (b. 1963)

In office since 1 February 2014

Management and supervisory positions

- Board member, Stichting Pensioenfonds TNO
- Supervisory Board member and member, Stichting Sint Antonius Ziekenhuis Audit Committee
- Supervisory Board member and chair, Novec BV Audit Committee
- Board member, Netherlands Association of Financial Executives

J.T.F. Keurentjes, CSO (b. 1963)

In office from 1 February 2014 to 31 December 2018

Management and supervisory positions

- Lecturer, Eindhoven University of Technology
- Board member, TKI HTSM
- Member of management team, Energy Top Sector
- Member of Supervisory Board, TKI Bio-Based Economy
- Member of Steering Committee, National Research Agenda
- Member of the Technology and Innovation Committee of VNO-NCW (Dutch employers' federation)
- Board member, Nationaal Regieorgaan Praktijkgericht Onderzoek SIA (NRPO-SIA)
- Member, General Management, Stichting Toekomstbeeld der Techniek (STT)
- Board member, Stichting Hoogwerff-Fonds
- Supervisory Board member, Ventinova Medical

W.C.A. Maas, Secretary (b. 1967)

Since 1 January 2018

MEMBERS OF THE SUPERVISORY BOARD

C.A. Linse, Chair (b. 1949)

In office since 1 March 2011; second term until 1 July 2019

Management and supervisory positions

- Supervisory Board member, AKZO Nobel Nederland BV
- Supervisory Board member, MRC Global Inc. Houston
- Chairman of MER Committee
- Chairman of the Supervisory Board, LUMC, Leiden

P.J.M. van Laarhoven, Deputy Chair (b. 1959)

In office since 1 October 2016; first term until 1 October 2021

Management and supervisory positions

- Member, Strategic Logistics Platform (Logistics Top Team)
- Chairman, Supervisory Board, CQM
- Chairman, Supervisory Board, Havenbedrijf Moerdijk
- Member, Supervisory Board, CB Logistics
- Member, Advisory Board, H&S Group

I.H.J. Vanden Berghe (b. 1962)

In office since 1 February 2011; second term until 1 February 2021

Management and supervisory positions

- General Administrator, National Geographic Institute
- President, Eurogeographics (until 10 October 2018)
- Member of the Board of Administrators General of the parastatal organisations
- Chair of the G-Cloud Strategic Board of the Federal Government
- Visiting Professor at Catholic University of Leuven
- Director of Flemish Institute for Technological Research (VITO)
- Member of the Management Committee of the Royal Museum for Central Africa (Tervuren, Belgium) and the Royal Institute for Natural Sciences

J.M. Bensing (b. 1950)

In office from 1 September 2008 to 1 September 2018

Management and supervisory positions

- Professor Emeritus since 1 April 2015
- Emeritus Honorary Research Fellow, Netherlands Institute for Health Services Research (NIVEL)
- Professor Emeritus at Utrecht University, Department of Social Sciences
- Member, Royal Netherlands Academy of Arts and Sciences (KNAW)
- Deputy Chair, Supervisory Board, Flevoziekenhuis Hospital
- Deputy Chair, Supervisory Board, Twente Medical Center
- Member, Supervisory Board, De Hoogstraat convalescence home
- Member, Supervisory Board, Waarborgfonds van de Zorg (WfZ) (Guarantee Fund)
- Auditor for the accreditation of healthcare executives (NVZD/Dutch Association of Healthcare Executives)
- Member, Evaluation Committee, Health Council of the Netherlands

Ms J.M. Bensing was honourably discharged on 1 September 2018 as a member of the Supervisory Board on completion of her second term.

H. Bijl (b. 1970)

In office since 1 September 2018; first term until 1 September 2023

Management and supervisory positions

- Vice-Rector Magnificus and member of the Executive Board of Leiden University
- Professor of Numerical Mathematics, Mathematics and Natural Sciences, Mathematical Institute
- Supervisory Board member, Aviolanda Business Park
- Board member, Leiden BiosciencePark Foundation

I.G.C. Faber MBA (b. 1968)

In office since 1 October 2009; second term until 1 October 2019

Management and supervisory positions

- Chief Executive Officer, Pooling Partners/
Faber Halbertsma Groep
- Member, Supervisory Board, Jaarbeurs Utrecht
- Member, Supervisory Board, Probos

J.D. Lamse-Minderhoud (b. 1969)

In office since 1 November 2014; first term until 1 November 2019

Management and supervisory positions

- Member, Management Board, PricewaterhouseCoopers Nederland (PwC)
- Member, PwC Europe Executive Team

P.P.C.C. Verbeek (b. 1970)

In office since 1 May 2012; second term until 1 May 2022

Management and supervisory positions

- Professor, Philosophy of the Human Being and Technology, University of Twente
- Co-director, University of Twente DesignLab
- Honorary Professor Adjunct, Aalborg University
- Member of UNESCO World Commission on the Ethics of Science and Technology (COMEST)
- Board member, Rathenau Instituut
- Member, NWO programme board for Socially Responsible Innovation
- Member, Council for the Humanities, Royal Netherlands Academy of Arts and Sciences (KNAW)
- Member, National UNESCO Committee in the Netherlands
- Member, Royal Netherlands Academy of Arts and Sciences (KNAW)

W.C.A. Maas, Secretary (b. 1967)

In office since 1 January 2018

MEMBERS OF THE COUNCIL FOR DEFENCE RESEARCH

W. Nagtegaal, Chair until 1 January 2019

M. Gazenbeek, Deputy Chair

H.G. Geveke

Gen Maj E. Schevenhoven

A.P. Venema

M.P.I. Manders, Secretary

MEMBERS OF THE STRATEGIC ADVISORY COUNCILS

All nine market-driven and mission-driven Units each maintain a Strategic Advisory Council (*Strategische Adviesraad/SAR*) with representatives from the corporate sector, the government and research and educational institutions. These provide advice on strategic objectives, as well as identifying new trends and developments. The Councils serve an important function within TNO's innovation strategy.

Since 2018, the term of the members of the Advisory Council is equal to the period for the Strategic Plan, giving the added value an additional dimension.

Construction, Infrastructure & Maritime Unit

Chair: J.H. Dronkers

Circular Economy & Environment Unit

Chair: To be appointed

Defence & Security Unit

Chair: General Major (BD) A.C.J. Besselink

ECN Part of TNO Unit

Chair: G.J. Lankhorst (VEMW)

Healthy Living Unit

Chair: H.A.P. Pols

Industry Unit

Chair: E.M. Meijer (Representative for Chemical Top Sector)

Information & Communication Technology Unit

Acting Chair: R. Penning de Vries (Photondelta representative)

Mobility & Logistics Unit

Chair: R. van Gijssel

Strategic Analysis & Policy Unit

Chair: K.M. Becking (Chairman of Executive Board, Tilburg University)

[Click here](#) for a comprehensive and up-to-date list of the members of the Strategic Advisory Council by Unit.

› ACKNOWLEDGEMENTS AND CONTACT INFORMATION

› For further information about TNO, or if you have any questions or suggestions further to this report, please contact info@tno.nl.

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for life