



IN BRIEF



2015



TNO innovation
for life



GET TO KNOW TNO

› WHO WE ARE

We, TNO's 3.000 specialists, work together on the practical application of knowledge. We connect people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society. This is our mission – a mission of which we are proud. Our multidisciplinary research is of social and economic relevance, as laid down in TNO's principles adopted more than eighty years ago. Our sophisticated solutions to complex problems make the sustainable difference, both for today and tomorrow. This enables us to make a contribution to a better world: *Innovation for Life*.

› WHAT WE DO

We make use of our knowledge and experience to develop sophisticated solutions to complex problems. We work on issues in five fields of significance to society: Industry, Healthy Living, Defence, Safety and Security, Urbanisation and Energy. We carry out our work on the basis of a range of expertises and disciplines that are brought together in the Technical Sciences and the Earth, Life and Social Sciences Expertise Centres.

TNO's staff are creative, ambitious, and driven by their great social involvement. Our knowledge is widely recognized at a national and international level. Many members of TNO's staff are active in the scientific community or in public advisory organizations. This places us in the middle of society.

› HOW WE WORK

We connect the knowledge and experience of our staff with those of our partners, clients, and other knowledge organizations. We work on sustainable solutions in cooperation with and for more than 3000 companies – including companies in the SME sector – in the Netherlands and abroad, public authorities, and international and social organizations. We develop knowledge and apply knowledge in practice. We carry out our work on the basis of one-to-one relationships with companies or organizations and, increasingly, as a partner in public-private partnerships. In addition, in some instances we perform a specific duty that the government has assigned to TNO, for example as a strategic partner to the Dutch Ministry of Defence and the Geological Survey of the Netherlands. All these forms of cooperation enable TNO to add its value.

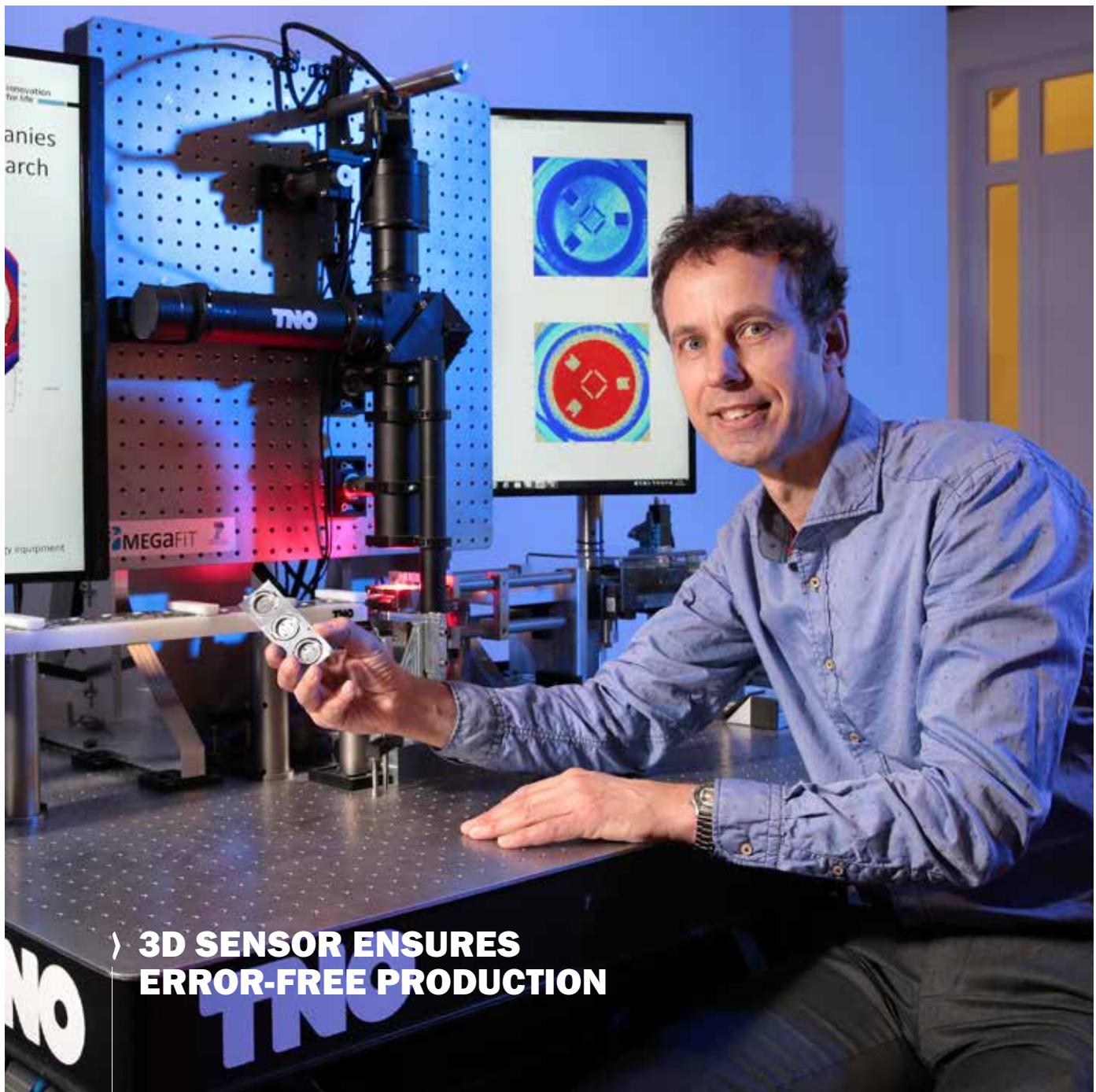
› GET TO KNOW TNO

IN BRIEF 2015 offers you information about representative examples of our work – innovations developed in cooperation with our partners and of which we are proud.

Are you interested in more information about TNO and the five social themes that form the focus of our work? If so, surf to www.tno.nl. Visitors to our website can also take out a subscription to our TNOTIME magazine or our digital newsletters.

Are you seeking specific expertise within TNO? If so, contact the TNO Infodesk: +31 (0)88 8660866, infodesk@tno.nl.

**TNO CONNECTS PEOPLE AND KNOWLEDGE
TO CREATE INNOVATIONS
THAT BOOST THE SUSTAINABLE
COMPETITIVE STRENGTH OF INDUSTRY
AND THE WELL-BEING OF SOCIETY**



› 3D SENSOR ENSURES ERROR-FREE PRODUCTION

'Our 3D sensor prevents wastage,' System Engineer Rob Snel explains. The sensor was developed within the European MEGaFIT (Manufacturing Error-free Goods At First Time) project in which fifteen partners collaborated with the aim of reducing the wastage of stamped metal products. The 3D sensor is essential in this. Snel: 'It can measure two stamped products per second up to micrometre precision – a thousand times faster than had previously been possible. The data are directly coupled to the stamping press, so deviations are immediately corrected. Subsequent stamped products are thereby guaranteed to comply with highly precise tolerances, which prevents reworking and wastage.'

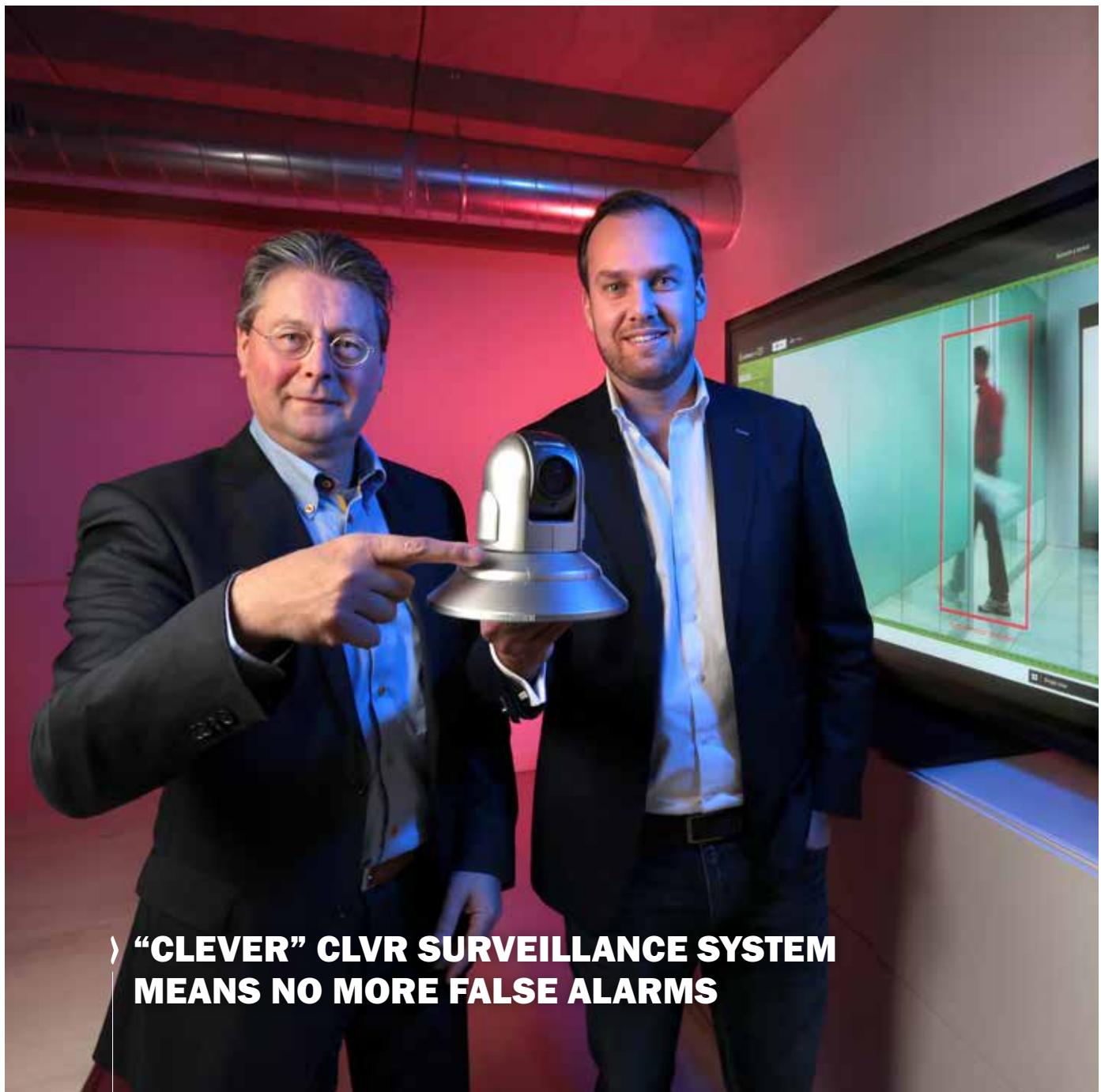
The 3D sensor is situated in-line in the stamping press and is adjusted to a specific production process. Snel is currently talking to a Dutch SME about the production, sale and service provision of the 3D sensors; and together they are talking with companies from the automotive, steel and semiconductor industries as well as with manufacturers of consumer goods and medical products. MEGaFIT is part of the "Smart Industry" programme. Snel: 'At www.smartindustry.nl you can see that this programme aims to strengthen Dutch industry by maximising the use of the latest technological developments in IT and sensors. So that companies can produce more efficiently, flexibly, qualitatively better and in a customised way. Our sensor helps realise this!'



› **HEALTHBREAD: HEALTHIER AND TASTIER WHOLEMEAL BREAD**

'Thanks to our knowledge much healthier bread can now be bought in Italy, Germany and Austria. France, Turkey, the US and the Netherlands will soon follow,' food scientist Martijn Noort, TNO project leader of the EU HealthBread project, says. This project, conceived and set up by TNO, builds on the EU HealthGrain project that focused on a healthier way of processing grain. The aim of HealthBread is to bake bread that tastes like white bread but which contains all the healthy natural ingredients of wholemeal bread. Noort: 'White bread is the preferred choice in Southern Europe. The Dutch and Germans eat a lot of multigrain bread but this often tends to be white bread with colouring and a few grains.'

In addition to TNO and the Finnish VTT, the HealthBread consortium comprises eight SME bakeries from the Netherlands, Italy, Austria and Germany along with suppliers. Using special grain fractions, long rising processes and a modified dough composition, bread with more nutrients and a good taste, colour, structure and volume was developed. Noort: 'The next step is for bakeries to use our knowledge to develop and sell bread products. So we have got together with the Netherlands Bakery Centre to produce a manual for bakers. The Dutch bakeries Kamstra and Uljee are really enthusiastic. The appetite has been whetted!'



› “CLEVER” CLVR SURVEILLANCE SYSTEM MEANS NO MORE FALSE ALARMS

Surveillance cameras set off an alarm if something moves, whether it's a person or even a swaying tree or wandering dog. As SME manager Boy Kodde suggests: 'All too often it's a false alarm.' The new CLVR surveillance system, developed using TNO's knowledge of image recognition and motion detection, sets off an alarm only for people who display deviating behaviour or a car that regularly drives past slowly. Where something suspicious is detected, users receive a warning via their smartphone or by e-mail; they can check out the pictures via the cloud. The TNO technology was developed in the context of long-running projects for Defence or the police.

The CLVR surveillance system has been on sale since mid 2014. Kodde: 'We presented our technology in 2011 at our annual TNO "Technology seeks entrepreneur" event.' Two SMEs showed interest: VicarVision (producer of software that recognises people) and Cameramanager, which builds the software into the camera and now sells the CLVR surveillance system. 'A nice example of how we and SMEs get innovative TNO technology successfully to market. During the collaboration Cameramanager was acquired by Panasonic, which means that the "clever" surveillance system is now also for sale outside the Netherlands.'



› SOLAROAD: A SMART ROAD

A glass, translucent top layer – a kind of ‘bridge road surface coating’ – not only protects the fragile solar cells in the cycle path but also gives the cyclist a surface with good grip for the bicycle. ‘We developed a transparent coating that allows light through’ explains initiator Sten de Wit. ‘The electricity generated is direct current, which is converted to alternating current and then transported to the power grid.’ Seldom has TNO had so much attention from both regional, national and even international media as for the official opening of the SolaRoad at Krommenie on 12 November 2014. For the project a consortium was formed with the Province of Noord-Holland (road authority), Ooms Civiel (producer of cycle path panels, cycle path construction), Imtech (electric

installations) and TNO (initiator, knowledge input and overall orchestration). The parties are co-financing the project. Most cyclists are positive about the cycle path, which is generating more electricity than expected according to De Wit. He is keen to see more than the seventy metres that is already there. ‘In this innovation project we are developing a road surface that will allow much of the 140,000 km of roads in the Netherlands to produce electricity: that’s an area greater than all of the roofs that are suitable for solar panels!'



› LEARNING TO COUNT IN SUDAN VIA GAMING

'At the end of 2014 Unicef selected our e-learning method as an Innovations in Education programme showcase,' says educationalist Hester Stubbé-Alberts proudly. 'We have developed a game for children in cooperation with War Child, Afhad University for Women in Khartoum (which prompted the question), Amsterdam-based game builder Flavour, the Sudanese Ministry of Education and Unicef. Our research gives War Child the evidence base it needs to scale this up so that within a couple of years at least a million children can work with this game.'

Stubbé is coordinating this project in which children in remote villages in Sudan, where there is often no school, can learn to count on a tablet in simple Arabic using a Dutch computer game. Following an initial experiment in 2012-2013, in October 2014 a pilot project got under way for 600 children in 19 Sudanese villages to learn to count via games. The tablets are managed by the facilitator who has daily contact with the project's leaders in Khartoum. In the villages there is no electricity but in each participating village War Child has installed a solar panel to charge mobiles and tablets.



THE SMART BICYCLE VIBRATES WHEN THERE IS DANGER

'Cyclists are vulnerable road users and older cyclists tend to fall more often than other adult cyclists. If you can offer them some support, then they will become more confident and fall less often,' says Maurice Kwakkernaat, leader of The Smart Bicycle project. In 2013 TNO began to co-develop the smart bicycle with the Cyclists Association and Roessingh Research and Development at the request of the government.

Kwakkernaat: 'We have specially adapted the sensors already being used in cars for the bicycle. And on a bicycle vibrations are a better warning signal than a sound or a lamp.' Radar detects poles and kerbs; the cyclist receives a signal through vibrators in the handlebars. In the rear mudguard there is a camera that detects dangers coming from behind

and these are transmitted by vibrators in the saddle. Under the rear rack is a flat box full of electronics. The smart bicycle looks just like a normal electric bicycle, is easy to ride and weighs about the same. Kwakkernaat: 'The extra safety items cost between 100 and 150 euros. We are currently talking with a number of bicycle manufacturers and suppliers at home and abroad.'



› SUPPORTING F-16 REPLACEMENT

'The government has decided to replace its F-16s with the American F-35 jet fighter. That's something that only happens once in your working life,' says Dolf Bos, former project leader of the TNO project 'Supporting F-16 replacement'. Together with colleague Bram Visser, he has been detached to the Netherlands Royal Air Force and the two are currently providing support in operational tests with the two F-35s purchased by the Dutch air force at Edwards airbase in California. Over the next five years four Dutch pilots trained in the United States will be testing the extent to which this weapons system complies with the operational requirements for Dutch missions.

TNO has supported Defence for years in the replacement process, such as comparing various candidate aircraft, analysing noise levels in the environment when the aircraft engines are tested following maintenance and analysing the lifetime costs of the F-35. Bos: 'TNO is now building two simulation environments for Defence, one to assist in maintaining the fleet and the other to support the development of tactics and procedures. By participating in the testing in the United States, you can help refine the mission scenarios for the customer and keep your models up to date.'

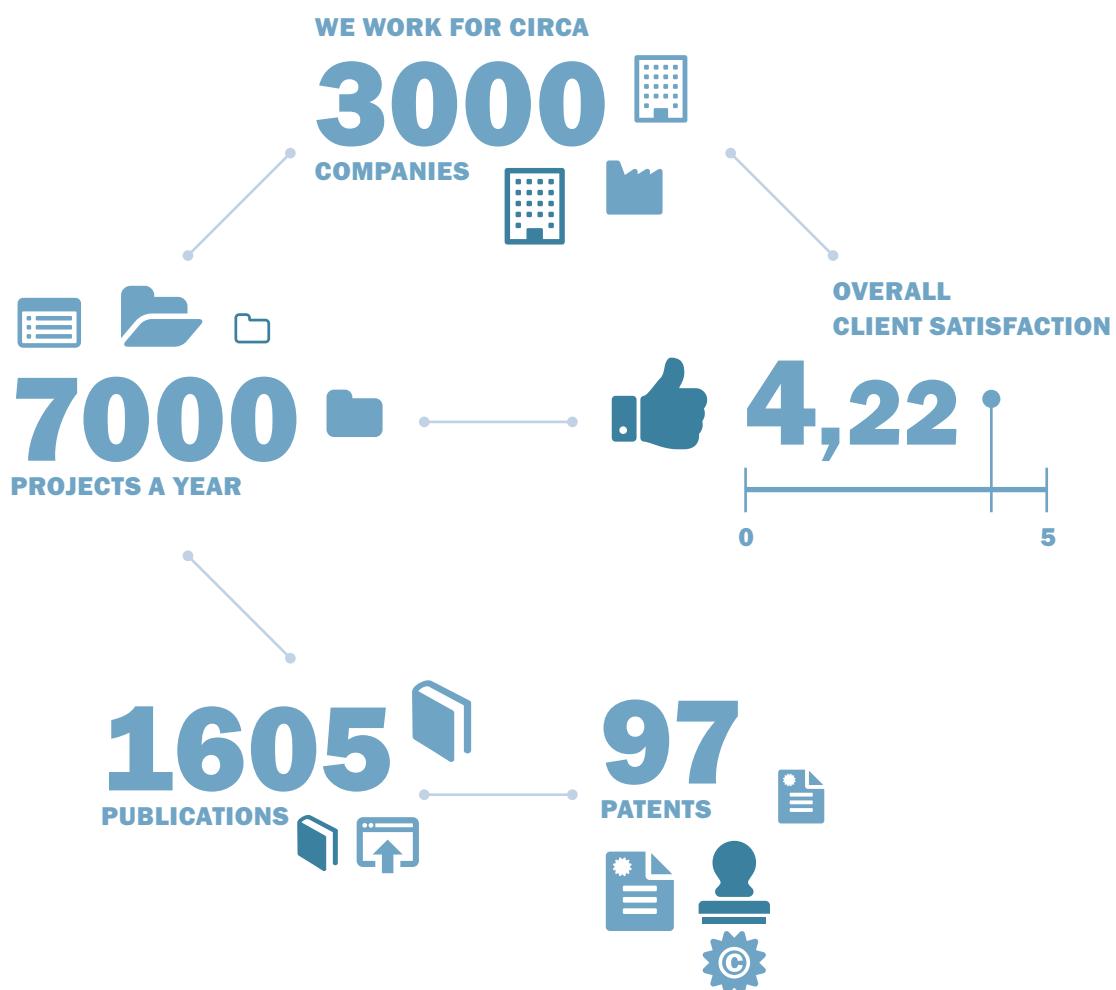


› HOW MUCH DO HOUSES VIBRATE?

'How much does a house move when earth tremors occur, and what is the damage in the end?' Marc Hamburg, senior project manager of the TNO project 'NAM Monitoring Network', suggests we don't yet know enough about the effects of earthquakes on buildings in the province of Groningen. TNO is using a sensor network commissioned by the NAM to investigate the effects on buildings. Hamburg: 'In the gas production area we placed sensors in 180 houses and 20 public buildings in a radius of 15 kilometres around Loppersum and connected them to a specially designed IT infrastructure. The registered data are also automatically conveyed to the residents concerned. If there is a tremor of 2.5 or more on the Richter scale, then someone from TNO

visits each home where a threshold vibration level is exceeded to record the damage. Hamburg: 'The residents set great store by our impartiality. We provided them with as much information as we could, for example during two information evenings. And, importantly, we listened to what they had to say. In the future we will remain in contact with them to inform them about and involve them in this monitoring network.'

› SIZE TNO 2014



TNO IN FIGURES

TNO ORGANIZATION INCLUDING GROUP COMPANIES

(in EUR x miljoen)

	2014	2013	2012
RESULT			
Operating income	540,6	579,0	606,0
Of which revenue	526,4	564,1	587,0
Of which other operating income	14,2	14,9	19,0
Breakdown of revenue			
Market revenue	355,2	383,6	394,7
Central government contribution to programme funding	171,2	180,5	192,3
EXPENSES			
Operating expenses	533,6	593,4	617,4
Of which employee expenses	335,8	381,7	379,2
Impairment	-	-	9,0
Net result	8,8	-14,5	-9,6
Revenue per employee (thousands of euros) ¹⁾	137,2	134,3	134,7
Annual cashflow	-5,3	-1,8	-19,5
CAPITAL			
Capital employed ²⁾	228,2	235,9	251,1
Equity	174,6	165,9	180,4
Solvency ³⁾	0,46	0,41	0,44
ACTIVA			
Property, plant and equipment	186,0	191,1	197,1
Additions to property, plant and equipment	29,2	25,5	21,9
EMPLOYEES			
Average number of employees	3.599	3.895	3.892

1) Revenue per employee = revenue divided by total workforce

2) Capital employed = total assets – current liabilities

3) Solvency = equity divided by total capital

› GET TO KNOW TNO

INDUSTRY

TNO STRENGTHENS THE INNOVATIVE POWER OF INDUSTRY THROUGH INNOVATIONS IN ICT, PRODUCTS, PROCESSES AND VALUE CHAINS, THROUGH PARTNERSHIPS THAT GENERATE GROUND-BREAKING AND SUSTAINABLE MACHINES, INSTRUMENTS AND CONCEPTS.

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HEALTHY LIVING

TNO INITIATES TECHNOLOGICAL AND SOCIAL INNOVATION TO ENABLE OUR LIVES TO BE HEALTHY AND TO CREATE VITALITY FOR LIFE.

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DEFENCE, SAFETY & SECURITY

TNO FOCUSES ON A SECURE SOCIETY BY CREATING INNOVATIONS TO ASSIST THE WORK OF PEOPLE IN DEFENCE, POLICE, EMERGENCY SERVICES AND INDUSTRY.

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TECHNICAL SCIENCES

TECHNICAL SCIENCES WITHIN TNO WORK ON SOLVING THE ISSUES THAT ARE THE FOCUS OF THE FIVE TNO THEMES BY EMPLOYING TOP QUALITY PEOPLE WITH TECHNOLOGICAL KNOWLEDGE IN FIELDS SUCH AS NANOTECHNOLOGY, ICT, DEFENCE TECHNOLOGY AND THE DYNAMICS OF STRUCTURES AND FLUIDS.

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Director of Research
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URBANISATION

TNO HELPS TO CREATE INNOVATIONS FOR DYNAMIC URBAN REGIONS BY WORKING WITH PARTNERS ON TODAY'S SOLUTIONS AND TOMORROW'S OPPORTUNITIES. WITH PARTNERS WE IMPROVE THE QUALITY OF LIFE, THE ACCESSIBILITY AND THE COMPETITIVENESS OF THESE URBAN REGIONS.

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TNO COMPANIES BV

TNO COMPANIES (TNO BEDRIJVEN BV) COMMERCIALISES KNOWLEDGE DEVELOPED BY TNO BUT WHICH IS NOT IMMEDIATELY TAKEN UP BY THE MARKET. WE WORK WITH INDUSTRY AND INVESTORS TO ACCELERATE THE COMMERCIALISATION PROCESS. TNO COMPANIES IS ALSO RESPONSIBLE FOR SETTING UP SPIN-OFF COMPANIES FOR TNO ACTIVITIES.

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EARTH, LIFE AND SOCIAL SCIENCES

WITHIN TNO EARTH, LIFE AND SOCIAL SCIENCES, GEOSCIENTISTS, SYSTEM BIOLOGISTS AND SOCIAL SCIENTISTS, SUCH AS BEHAVIOURAL SCIENTISTS AND PSYCHOLOGISTS, WORK ON THE CHALLENGES THAT ARE THE FOCUS OF THE FIVE TNO THEMES.

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QUESTIONS?

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