

FIVE THEMES

'NANOMANUFACTURING AND QUANTUM COMPUTING'

HAMED SADEGHIAN, PRINCIPAL SCIENTIST NICOLE NULKES-DE GROOT, EARLY RESEARCH PROGRAMME, 3D MANUFACTURING 'TNO has brought together leading researchers from the private sector and scientific field to raise 3D nanomanufacturing to the next level. One aspect that makes our work particularly interesting is the involvement of young researchers. PhD students inspire us with their new perspectives and approach. The essence of our applied research is teamwork, both internal and external. Rapid innovation demands collaboration with and between universities, knowledge institutes and industry. Research in the field of 3D nanomanufacturing has already given rise to several promising new applications. We have opted to focus on two specific areas: healthcare and quantum computing. In healthcare, for example, we are now developing early diagnosis techniques based on the use of nanoparticles that are actually introduced into the patient's body. Early diagnosis is often the key to effective treatment.

Nanotechnology will also have a significant impact in terms of portable IT devices: smartphones, laptops and tablets.

'GIANT STEP AHEAD FOR PUBLIC HEALTH'

The desire is to make processors ever smaller, but existing technology places limits on the degree of miniaturization that can be achieved. We are exploring and

pushing back those limits. We are now working to develop the quantum computer within QuTech, a partnership of TNO and TU Delft with input from various companies including Intel and Microsoft. Our efforts will lead to a revolution in computer technology, with processors many times faster than the current generation. We are also working on another application of quantum technology: secure and "uncrackable" communication technology. In all cases, the production processes must be closely monitored. Tolerances are exact; there is no margin for error. We have joined a large industrial partner to develop a new, innovative production control method. Nanomanufacturing and quantum technology thus complement each other perfectly.'





'Have you any idea how many welders there are in Europe? Almost 750,000. And they are exposed to hazardous substances every day,' states TNO researcher Andre Moons. 'My colleague Bas Knoll and I found this an unacceptable situation. Inhaling welding fumes can lead to pulmonary and cardiovascular disease. There are safety regulations and statutory exposure limits but they are not particularly effective in practice. We have found situations in which the upper limits were exceeded by a factor of ten. We decided that the technology must be improved, so we assembled a multidisciplinary team of TNO experts including industrial designers and specialists in emissions. respiratory disease, hazardous substances, human-technology interaction and ergonomics. We designed a welding torch that reduces the operator's exposure to hazardous fumes by over 95 per cent. We then found a company willing to develop and market the product: Translas, a Dutch manufacturer of welding equipment which exports to over forty companies worldwide. The iTanks innovation centre in Rotterdam provided investment.

'MUCH **CONTRIBUTION** BY WELDERS'

much a joint project to which all partners have made

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a contribution based on their own area of expertise. We see this as the only way in which to arrive at a worthwhile practical innovation. Welders themselves have also made a significant contribution, telling us what will and will not work in practice. The new torch has now been tested by hundreds of welders in the Netherlands and elsewhere. All report that it is more comfortable and pleasant to use than the conventional equivalent, yet produces results of equal quality. They welcome the extra protection it provides.' TNO has earned international recognition for the device in the form of the Innovation Award for Applied Science 2015, presented by the European Association of Research and Technology Organizations (EARTO), which has some one hundred members. 'Of course we are proud of the award, but we are even more proud to have improved the health of the welding profession. There has been considerable interest from Europe and the United States. I would like to see our torch being used by all welders in the world, whereupon occupational disease will become a thing of the past,' says André Moons.



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DEFENCE RESEARCH CREATES NEW BUSINESS ACTIVITY

MYRA VAN ESCH-BUSSEMAKERS, DIRECTOR, HUMAN FACTORS 'Bring the Ministry of Defence (MOD) and TNO together, invite other research institutes to contribute, involve private sector companies large and small, and you have a very fertile seedbed for innovation. October saw the very successful launch of the AEOLUS Human Performance Innovation platform. In Greek mythology, Aeolus was the ruler of the winds. The aim is to step up research examining human physiology and performance in extreme circumstances, such as (military) aviation and space exploration. We intend to stay one step ahead of the rest of the world.

The partnership between the Royal Netherlands Air Force's Centre for Man and Aviation (CML) and TNO represents a very strong knowledge position. Topics of interest include commercial space travel. There may soon be flights taking passengers to an altitude of 100 kilometres to experience a few minutes of weightlessness. What effect will this have on health or long-term performance? No one yet knows, but the answer is also interesting to the MOD in terms of the ability to deploy troops

'COMPANIES ARE **EAGER** TO TAKE PART IN THIS TYPE OF RESEARCH'

quickly: will it be possible to send an operational contingent to the other side of the world within hours? Another area of interest is how pilots will function in the

new F35 Joint Strike Fighter aircraft. They are to wear a helmet which acts as an interface with all systems, and special clothing to counteract the effects of the massive G-forces. Everything has been designed to perfection in terms of the technology and systems, but we are interested in how we can optimize the performance of the pilots themselves.

It is gratifying that so many companies are eager to take part in this type of research, from rollercoaster builders to new computer games developers. They inspire us to think "outside the box", while we help them to spot new business opportunities. I am confident that our collaboration will result in some spectacular innovations.'



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'Just imagine – congestion has been resolved and you no longer find yourself sitting in a traffic jam every morning. Fuel consumption and carbon emissions have been cut by ten per cent. All this has been achieved by interconnecting vehicles so that they can travel in convoy. In the truck platooning concept, only the lead vehicle has a human driver. All other vehicles in the convoy 'follow the leader'. They brake, accelerate and are steered automatically.

This is no pipe dream. I am convinced that truck platooning will be seen on our roads within a few years. In March 2015, we demonstrated the DAF EcoTwin system using two interconnected trucks. In 2016, we shall move on to the next step. To coincide with the Netherlands' presidency of the European Union, the Ministry of Infrastructure and the Environment, the Department of Transport and Public Works (Rijkswaterstaat) and the Netherlands Vehicle Authority (RDW) are to organize the European Truck Platooning Challenge. This gives the field the opportunity to consider all aspects: robust vehicle automation,

'I'M CONVINCED WE'RE GOING TO MAKE THIS HAPPEN'

communication technology, legislation, acceptance. liability and insurance. It has to be an

international process because the new automated trucks will not be confined to Dutch roads. They will serve all European routes. TNO has acquired a strong reputation in driverless vehicle technology. We have extensive knowledge of the technology itself, development and validation methodologies, legislation and human behaviour. It is this combination that makes us unique. We have also built a strong international network of vehicle manufacturers, secondary suppliers, government authorities, insurance companies and logistics operators. Their collaboration will bring cooperative vehicles to fruition that much sooner. It is not so much a ground-breaking feat of technology but a logistic innovation which will make road transport cleaner, safer and more efficient, thus increasing the Netherlands' competitive strength.'



DAF and TNO demonstrate EcoTwin 2016 European Truck Platooning Challenge



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Government policy, as set out in the Energy Agreement, provides for the construction of offshore windfarms which will generate enough electricity to supply some three million households. At present, offshore wind energy remains more expensive than that produced by burning fossil fuels. Costs, including those of installation and maintenance, must be reduced. But how? Experts in several disciplines, including steel fatigue, statistics and dynamics, have turned their attention to this question. As TNO project manager Gerard van der Weijde explains, 'Experienced researchers are working alongside their keen young counterparts. All are eager to develop new knowledge.' Several project proposals have been awarded funding by the Top Consortium for Knowledge and Innovation in Offshore Wind (TKI WoZ) and its affiliated companies and organizations. 'At our Structural Dynamics Lab we have set up several trial installations of various sizes in which we can simulate the extreme loads on the wind turbines, both above and below water. We then use the resultant data to produce new predictive calculation models

'EXTENDING OPERATIONAL LIFETIME BY 20% WHILE REDUCING INSPECTION REQUIREMENT'

for metal fatigue. The statisticians are developing a probability model to determine the ideal inspection frequency based on past inspection findings and costs. The aim is to be able to predict the useful working life of an offshore wind turbine

with a much higher degree of accuracy. This will allow operators to conduct fewer maintenance inspections, thus reducing lifetime costs. The current estimates are extremely conservative. We believe it is possible to extend the operating lifetime by twenty per cent while cutting the number of inspections by half. This will reduce the total cost of ownership and enable operators to charge less for the electricity they generate, making offshore wind energy that much more attractive. We are now at the halfway point of our research and lab tests. Companies from several countries have expressed interest in the results, which gives us an extra incentive to make a good job of it.



ACKNOWLEDGEMENTS AND CONTACT INFORMATION

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TEXT: TNO, Dik Binnendijk, Ruud van der Ros

DESIGN: C&F Report, Amsterdam

PHOTOS: NFP Photography, Pieter Magielsen

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