TWENTE GRADUATE SCHOOL
SCIENCE BASED ENGINEERING
GRADUATE SCHOOL

UNIVERSITY OF TWENTE.
DISCLAIMER
Although this brochure was compiled with the utmost care, no rights can be derived from its contents.
The focus of the cluster Science Based Engineering (SBE) is to improve the world by designing and developing new advanced technologies. Characteristic for engineering is that problems are analysed, possible solutions are generated and their effects judged. The latter can lead to reformulation of the problem definition resulting in new solutions. Science Based Engineering is a solution oriented approach that iteratively combines problem analyses, solution generation and academic research.

Within Science Based Engineering, multidisciplinary and interdisciplinary research is carried out in the development of methods and technologies for design and realisation of new products and innovative processes and systems, based on a scientific approach. The product range varies from consumer products, tools, instruments, machines to collective products like infrastructure. In all cases the whole life cycle is considered. In the case of processes attention is focussed on production processes, construction processes, maintenance strategies, process technology and energy conversion. An important aspect is that the developed methods and technologies are applied in practice as demonstrator or prototype in collaboration with industry.

Science Based Engineering will be the breeding ground for excellent societal relevant education, research and research staff. The cluster will deliver excellent MSc, PDEng, PhD and Postdocs through its research programmes. They possess top-quality knowledge and can independently find answers for interdisciplinary and societally relevant problems by means of science based engineering and an entrepreneurial attitude.

Prof. dr. ir. André de Boer

AN IMPORTANT ASPECT OF SCIENCE BASED ENGINEERING IS THAT DEVELOPED METHODS AND TECHNOLOGIES ARE APPLIED IN PRACTICE AS DEMONSTRATOR OR PROTOTYPE IN COLLABORATION WITH INDUSTRY.
Next to the PhD research projects and PDEng technological Design projects, a broad variety of discipline related, academic skills and career development courses enable students to specialize in their research area they are interested in while broadening their perspective on the societal context of technology and research.

**SCIENCE-BASED ENGINEERING**

Science Based Engineering will focus on the initiation, design and development of technical solutions for societal problems of today, tomorrow and of the future. New technology serves as the innovation engine in society. The objectives of the programme are to generate fundamental knowledge and to use this knowledge to develop solutions for complex multidisciplinary technical problems. Within this context, the programme focuses on the integrated value chain. The societal relevance of the research will be secured by closely collaborating with industry.
RESEARCH AREAS

ENERGY AND PROCESS TECHNOLOGY
Research in theoretical, numerical and experimental fluid dynamics, granular materials and thermal engineering, driven by applications in fields such as mechanical engineering, maritime engineering, aerospace engineering and process technology. Research themes are aero-acoustics, fluid mechanics of rotating flow machinery, multi-phase flows, transport phenomena, thermo-chemical conversion, sustainable fuels, turbulent combustion, heat transfer, micro cooling, cryogenic cooling and superconductivity. This research area is embedded in the Programme for Science Based Engineering.

MECHANICS OF SOLIDS SURFACES AND SYSTEMS
Develop the technology for future manufacturing processes and new products by a science based engineering approach focused on material behavior, system behavior and robust optimization. Manufacturing new products and/or developing new processes requires a profound scientific understanding of (functional) materials (e.g. elastomers, polymers, composites, metals, bio-materials) and their interactions throughout the complete life cycle: during design, production, use and after service life. This research area is embedded in the Programme for Science Based Engineering.

DESIGN ENGINEERING
Research on the understanding and improvement of design processes (and consequently also manufacturing processes). A focal point is the development of methods and tools for scenario-based, user-oriented product design against the background of the requirements and constraints of the entire product life cycle. ‘Integration’ and ‘synthesis’ are important topics for design engineering research, the focus is on understanding and improving the design process irrespective of the product. Design as an intrinsic part of Engineering. This research
area is embedded in the Programme for Science Based Engineering.

BIOMECHANICAL ENGINEERING
Research at the interface of technological and medical sciences, aimed at improving rehabilitation of patients with sensory or motor disorders, resulting in their increased independence. The research will be focused in three themes, i.e. neural control of movement and posture, characterization of biological tissue behavior and the effect of (surgical) interventions, and development of methods to study human movement. The medical application areas of the research are rehabilitation, orthopedics and neurology.

This research area is embedded in MIRA Biomedical Technology and Technical Medicine.

CIVIL ENGINEERING
Research to acquire qualitative and quantitative knowledge on the life cycle of civil engineering systems and objects, with a particular focus on the initiative phase, the phase of conceptual or functional design, and the operation and maintenance phase, all in a societal and environmental context. Research concentrates on construction management and engineering (e.g. planning, development, procurement systems and construction engineering) transport studies (e.g. engineering, management and interaction of transport systems) and water engineering and management (physics of marine and fluvial systems and integrated water management).

This research area is embedded in Centre for Telematics and Information Technology, the Institute for Innovation and Governance Studies and the research programme of Geo-Information Science and Earth Observation.
SCIENCE-BASED ENGINEERING
STRUCTURED PHD, PDENG AND MSC
PHD

The PhD programmes are typically 4-year post-Master programmes with a strong focus on in-depth academic research. In general industry is one of the involved partners in the PhD projects, hence societal relevance is secured. The research topics are closely related to the research carried out in the participating research chairs. After a successful completion of the PhD, the candidate is awarded the title of Doctor (Dr.). Next to his/her research, the PhD student follows an educational program which is in the service of the research topic, but also inspires the broader view and personal development. Students are expected to take part in two advanced courses offered by the programmes that are relevant to the research of the student. Alternatively, the student can select suitable courses offered by one of the affiliated national research-schools. Each student must participate in at least two international workshops or conferences in the field of the PhD project. The supervisor will advise on suitable courses that will strengthen the development of the student.

PhD students have to complete, submit and publish a number of scientific papers in leading journals. The student will be expected to participate in courses focused on personal development including attention to technical writing and presentation skills, personal effectiveness and time-management at the Centre for Training and Development, or broadening and research management courses offered by Twente Graduate School. A selection of courses offered at the UT will be made to facilitate the student to work effectively within the Dutch context.

Each PhD student will have her/his own individual training and supervision plan for the PhD phase of the graduate programme, with a total volume of at least 30 EC.

Research schools for deepening courses: you can select suitable courses offered by one of the affiliated national research-schools, i.e., the J.M. Burgers Center (JMBC), the Dutch Institute on Systems and Control (DISC), Engineering Mechanics (EM) and the Netherlands Research School in Process Technology (OSPT).
The Professional Doctorate in Engineering (PDEng) is a 2-year post-Master technological design programme that combines academic research in an industrial context with taught modules in a range of related subjects. PDEng trainees are paid employees, either on the payroll of the university or on the payroll of the supporting client.

A challenging and innovative technological design project, defined by and carried out at the client, is the focal point of the programme. The project and the taught modules are programmed parallel to ensure that the newly gained knowledge can directly be transferred in technological innovations. The education part (~60 EC) at the UT has both a broadening and in-depth character, with ample attention for professional development. After successful completion of the programme, the trainee receives the certified degree PDEng. The cluster Science Based Engineering supports the following four PDEng programmes:
- Civil Engineering
- Energy and Process Technology
- Maintenance
- Robotics

For more information visit the PDEng website: www.utwente.nl/pdeng
ADMISSION REQUIREMENTS AND ENROLMENT

THERE ARE TWO WAYS TO ENROL INTO A TGS PROGRAMME. YOU CAN START A PhD PROGRAMME IF YOU HAVE ALREADY COMPLETED A MASTER’S PROGRAMME AT THE UNIVERSITY OF TWENTE OR ELSEWHERE, OR YOU CAN START A MASTER OF SCIENCE DEGREE PROGRAMME AT THE UNIVERSITY OF TWENTE AND PREQUALIFY YOURSELF FOR A TGS PROGRAMME.

ARE YOU CURRENTLY A MASTER’S STUDENT?

After successfully attaining a Master’s degree, you may enter a Twente Graduate School programme in the PDEng or PhD phase. PDEng and PhD candidates may either apply for a position available within one of the research groups or obtain their own funding.

VACANCIES
Unlike in many other countries, most PhD and PDEng candidates in the Netherlands are paid employees, often working directly for the university. Research projects are defined by the head of the research group, who then recruits graduate students to carry out project research. If a position is offered in a research field of your choice, you are kindly invited to apply to such a vacancy. Vacancies for PhD and PDEng positions at the University of Twente, including those connected to Twente Graduate School, are published on the vacancies website www.utwente.nl/vacancies.

OWN FUNDING
You may also enter a Twente Graduate School programme as PhD candidate with your own funding or with an international scholarship. In that case, research projects are initiated on the basis of proposals submitted by graduate students as part of their application procedure. A professor in a relevant field has to commit himself to the candidate and the proposed line of research.

Before a proposed research plan is taken into consideration, it must be clear that the candidate plans to submit an application for a secured funding scholarship. Please note that the University of Twente is not in a position to offer fellowships or similar funding for PhD candidates, other than the vacancies mentioned above. For information about the documents required for the application see: www.utwente.nl/tgs.
ARE YOU CURRENTLY A BACHELOR’S STUDENT?

BSc
- You have already obtained your Bachelor’s degree

MSc
- Two-year programme with discipline related courses, 120 credits*
- Opportunity to start integrated MSc/PhD programme in second year

PDEng
- PDEng technological Design
- Deepening, broadening, academic skills and career development courses, ~60 credits

PhD
- PhD research
- Deepening, broadening, academic skills and career development courses, 30 credits

*Some of our Master’s programmes are one-year programmes (60 credits).

If you currently are a Bachelor’s student or have recently obtained your Bachelor’s degree, and are interested in pursuing a PhD through one of the structured research programmes TGS coordinates, have a look at the Master’s programmes involved.

Talented students can write their PhD proposal as part of their Master’s degree programme. For more information about the Master’s programmes, the admission requirements, and the tuition fee have a look at: www.utwente.nl/master.

RESEARCH HONOURS
This excellence programme will be tailored to your needs and offers the deepening of theoretical and practical knowledge. You will acquire more knowledge by means of extracurricular courses, trainings and meetings. The programme is an addition to your Master’s programme.

TGS AWARD AND BRIDGING FUND
The TGS Award is open for six selected candidates in the last phase of their UT Master’s. They should have demonstrable research skills and above-average results. Up to six months of funding to bridge the period between graduation and full PhD funding is available for all candidates. The winner additionally receives a check of EUR 2,500 to be spend on doctoral training. Qualifying students can be nominated by a UT supervisor.

ADDITIONAL INFORMATION
If you would like more information about Twente Graduate School, please go to the TGS website www.utwente.nl/tgs.
SCIENCE, BUSINESS

ON THE BULLETIN BOARD OF JAN HARMEN WIEBENGA IN HIS FORMER ROOM IN THE UT DE HORST BUILDING THERE WAS ONCE A POSTER LISTING 20 REASONS WHY SPIN-OFF COMPANIES FAIL. NO. 1: “NO MARKET DEMAND FOR THE PRODUCT”. A FEW YEARS LATER, NOW WITH A DOCTORATE AND SEVERAL GRANTS IN HIS POCKET, WIEBENGA AND HIS COMPANION JOHAN HOL CONCLUDE THAT THE DEMAND FOR THEIR PRODUCT IS OVERWHELMING.
Wiebenga and Hol with their spin-off Triboform Engineering, which develops software packages in the field of friction modelling, have now landed in The Gallery at incubator Kennispark Twente. A deep-seated fascination with engineering and science is strong in both men. Even after their doctoral research they maintain close contact with research groups, other companies and, of course, their customers. “As researchers we believed that it was extremely important to know what is happening in the market, to ‘sell’ our own research and demonstrate social relevance. I think we have succeeded in this”, says Jan Harmen Wiebenga.

ROAD TO SUCCESS
Like so many before them, the duo did not immediately find the right path. Johan Hol: “We started with the development of software of which we believed: this is it. We initially focused on the optimization of transformation processes in metal. Still fresh in my memory is the time that we arrived at a large company and gave a presentation with 45 slides, 40 of which were about that original idea. Only at the end did we say anything about predicting tribological behaviour; the reactions were very enthusiastic. And we experienced this a few more times. We increasingly realized that we had found a gap in the market and have therefore made that shift.”

The pair are focusing on the development of a software package for predicting tribological behaviour. This is a branch of mechanical engineering that investigates the effects of contact between materials under various circumstances. During their PhD defence they acquired a wealth of scientific knowledge, published a lot in relevant journals and are now translating this into their current product. Triboform, helped a lot during the start-up by the UT, Tata Steel and the Materials innovation institute (M2i), is growing rapidly and is part of Kennispark Twente’s TOP scheme. In 2014, the spin-off received a commercial knowledge transfer grant (200,000 euros) from technology foundation STW.

LOTS OF INTEREST FROM THE AUTOMOBILE INDUSTRY
Wiebenga and Hol can count on a lot of interest from the market for their product. Their software package is mostly used in the automobile industry to accurately predict the tribological behaviour and the friction in the production processes for new parts, such as car bonnets or doors.

The pair obtained their doctoral degree within the Applied Mechanics department (Prof. Ton van den Boogaard) of the Faculty of Engineering Technology and still maintain close contact with the department. They have even filed joint applications for European projects. This also applies to the department of Dik Schipper.

PASSION ENGINEERING
When asked what turns a good scientist into a good entrepreneur, Jan Harmen doesn’t have to think for long. “That’s easy: obviously a good idea, support from the people around you, will-power and making the right choices.” For these two men, these ingredients are linked to a strong passion for technology and engineering. Jan Harmen: “I used to have all kinds of disassembled radios under my bed. That’s how it all started. In Twente, I was able to put this interest to use during my master’s degree in mechanical engineering. I wanted something that is widely used in engineering and technology, and dreamed of starting my own business. I have succeeded!”

Based on his engineering background and specialization in the transformation of metal, Johan Hol, originally from Rotterdam, wanted to focus more on the numeric field of mechanics-related problems. “After my final thesis project at Stork Fokker, I received the offer from the department to obtain a doctoral degree. To then develop your entrepreneurship on the basis of a scientific approach, is fantastic.”