3TU.School for Technological Design

STAN ACKERMANS INSTITUTE

The innovation degree

25 years of technological designer programs

TU Delft
Delft University of Technology

TU/e
Technische Universiteit Eindhoven
University of Technology

UNIVERSITY OF TWENTE.

Innovation is a word with probably one of the highest frequencies in recent policy statements of western countries. This demonstrates the awareness that we can only survive if we really realize innovative developments in industry as well as in society. Not only to cope with the strong economical competition from the Asian countries but also to cope with fundamental problems, such as the lack of fossil resources and the increased need for food.

Alexander H.G. Rinnooy Kan PhD

Preface

Although innovation should be everybodies concern, only a few can really make a difference. Universities have traditionally two tasks: research and education. The last decade a third task has been added, namely: innovation or knowledge valorization. Innovation is the right expression from the perspective of industry or society. However, for universities it is a way to transfer knowledge into value, which explains the term knowledge valorization.

European universities are still in the process of incorporating this task into their day to day operations. Academics like to teach and are triggered to perform research by their curiosity. However, for innovation another attitude and other skills are needed. While pure researchers are driven by curiosity and want to understand or predict phenomena, the real engineer wants to create value by means of the creation of new and innovative artifacts.

The programs of the 3TU.School for Technological Design, Stan Ackermans Institute train the best young engineers. In the first year of the program the trainees receive an extensive training, which prepares them to develop an innovative artifact during the one-year design project in the second year of the program. The trainees work on these design projects under supervision of the university staff and with active participation and guidance of the university staff and an industrial mentor. These trainees do not only become top-engineers, they also realize a real contribution to industry or society in the form of the outcomes of a design project.

This is what is truly meant with the third cycle in the Bologna treaty. In the first cycle, the bachelor level, the student has to acquire knowledge and skills. In the second cycle the student should demonstrate that he or she is able to apply the acquired knowledge independently, the master level. In the third cycle the students should deliver their own contribution, traditionally in the form of new knowledge but in the case of technological designer programs in the form of a useful and innovative artifact.

The first form fits the PhD program, while the second form matches the technological designer programs as delivered by the Stan Ackermans Institute, named after a remarkable university administrator whom I knew well and remember fondly. These programs are a perfect answer to the societal needs of today. However, they exist already for 25 years in the three universities of technology in the Netherlands! I know of the plans to bring these programs to a European level, and I hope that they will soon be recognized as one of the pillars of innovation in the European Community.

Alexander H.G. Rinnooy Kan PhD,
President of the Social and Economic Council of the Netherlands (SER)

Content

Dutch industry has got itself three thousand qualified designers since 1986. What once began as an urgent demand from an anxious industrial sector has grown into a successful tool for innovation.

From 'supernova' to successful innovation tool

Rector Stan Ackermans of Eindhoven University of Technology (TU/e) is a proud man on that Monday morning on September 2nd, 1985. He announces, during his opening address for the academic year, a new, two-year post-master designer program. With his usual metaphorical flair, he refers to the program as 'a supernova in the academic firmament'. The program owes much to his own efforts.

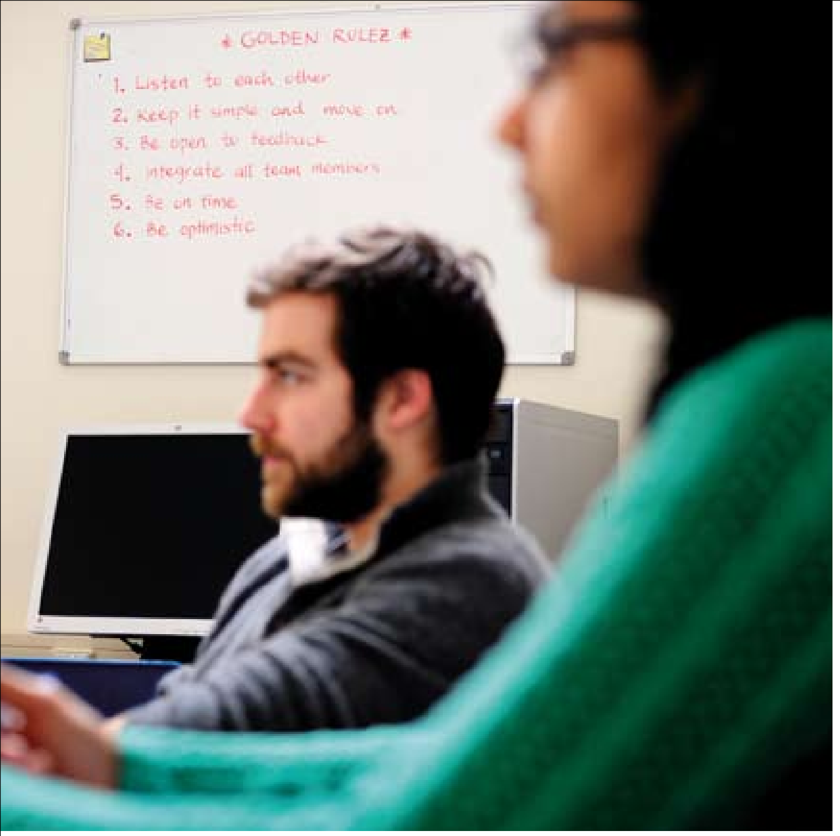
The world of education has been in a bit of a mess for a while. The new two-phase structure law introduced and implemented by the government hangs like a dark cloud above the universities. The era of the 'eternal student' is drawing to a close. Students now have four years to complete the first phase of their studies: a foundation year followed by a three-year Master's. A possible second phase of one or two years can allow the student to specialize even further, for instance, in teaching or design. A four-year PhD follows the first phase for those aiming for a scientific career.

1981
Two-phase structure Scientific Education Act passed by parliament. Starting in the academic year 1982/83 this must lead to new study programs

1982 - 1985
Professor Stan Ackermans is Rector of Eindhoven University of Technology

1982 - 1985
Start of the two-phase structure Scientific Education Act that remains in effect until 2002

1986
First four two-year designer programs get under way, substantiating the two-phase structure



In this context the Eindhoven, Delft and Twente universities of technology, along with the University of Groningen, decide to establish two-year designer programs initially intended to act as a 'catch-up'. The two-phase structure means that the engineering programs have to give up an entire academic year, restricting internship possibilities in particular. Dutch industry also expresses its considerable displeasure with the shortened science programs. They fear that this excessive focus on analysis and research will not link up well enough with industrial practice.

SHIFT IN DIRECTION

The designer programs are not merely ointment on the wound; they are the first tangible result of a significant shift in direction already set in motion within TU/e. In 1980, well before the introduction of the two-phase structure act, TU/e initiates the Quo Vadis committee. Its task is to draw up a vision of the future for the university. In November 1981 committee chairman, Professor G. Vossers, writes:

In practice, engineering progress demands increasing cooperation between the many engineering disciplines themselves and between these and other disciplines. This is an aspect that must have a place in education. Moreover, a good engineer must also have non-scientific qualities. (..) The 'skill' and the context must be reinforced in the educational program.

The designer programs announced by Stan Ackermans five years later and which officially begin in September 1986, also cater to the growing need for a more broadly educated student. Interdisciplinary work in a team situation, cost-consciousness, communication and presentation techniques, creativity and modern design methods gain a more prominent place in the curriculum. Participants follow theory for a year before taking on all kinds of practical design assignments in the second year. While the majority of the assignments during those years take place within the departments, students equally take part in design projects on companies' work floors. The content of the designer programs is, more clearly than before, focused on the needs of industry. And it is precisely this that makes them a 'supernova in the academic firmament'.

1987
Establishment of the Institute for Continued Education (IVO), incorporating the designer programs, with Stan Ackermans appointed director

1990
Presentation of the 100th designer degree in Eindhoven

1994
Many engineering studies resume five-year duration

1995
With the death of Stan Ackermans, IVO is renamed the Stan Ackermans Institute (SAI)

GENTLEMEN'S AGREEMENT

The original intention is to get 500 designers throughout the Netherlands ready each year for the market. This figure is reached by a 'gentlemen's agreement' struck by the universities in 1985 with the Ministers of Education and Economic Affairs along with the Central Employers Council about substantiating the second phase. But this figure is far too optimistic largely because the agreement fails to make clear how the programs will be funded. Initially the universities pay for the programs from their own pockets, with industry making equipment available and providing people to give lectures. The government, however, keeps its coffers closed.

In 1989 industry rings the alarm. The KNCV (Royal Netherlands Chemical Society), for instance, announces the chemical industry's need for at least 200 designers and researchers each year: four times the actual number of graduates. Employers urge a quick solution to be found for funding the second phase. That solution comes at the end of 1990 when the ministries of Education & Science and Economic Affairs promise a structural solution for the funding problem.

STRATEGIC RENEWAL

In Eindhoven the programs come within the IVO (Institute for Continuing Education), established in 1987. Stan Ackermans is director of the institute until his death in 1995. Following his death, the institute for which he gave his heart and soul is named after him: the Stan Ackermans Institute (SAI). At that moment Eindhoven caters for sixty percent of all designers trained in the Netherlands. Nonetheless, the institute is forced to reorganize in 1997 when the intake falls to almost half of what it was in 1993.
There are several reasons for this downturn. A revival in the job market makes further study for graduate engineers a less self-evident choice. The number of engineering students has been falling for years and now the engineer programs are once again five-year programs. The added value of the programs for both the students and industry is no longer so crystal clear. Indeed, there seems to be a discrepancy between what companies expect from a designer and the actual capabilities of the SAI graduates.

INTERNATIONALIZATION

Looking closely at the list of graduates from the Stan Ackermans Institute, it is immediately clear how much internationalization has occurred since 1995. In 1993 ten percent of students came from abroad; five years later this had increased six fold and in 2010 the ratio is around three in four.

The institute is an attractive employer for foreign talent. Designers in training receive a modest salary while following a study that gives them a clear advantage over new Master graduates. They get access to the Dutch business world and engage in the working culture. After graduating, most foreign designers stay on to work in the Netherlands. But the benefit cuts both ways: for Dutch industry the Stan Ackermans Institute with its stringent selection procedure acts as an excellent source of skilled, motivated personnel.

1996
Presentation of the 1000th designer degree in the Netherlands

1997
Restructuring of SAI, giving industry a bigger role. Professor Jack van Lint is the new director

1997
Graduates are awarded the title Master of Technological Design (MTD)

2000
Presentation of the 1000th designer degree in Eindhoven

DESIGNER PROGRAMS IN THE NORTH
From the moment the designer programs make their entry in the Netherlands, Eindhoven is the heart of the programs. The majority of the designers still graduate from TU/e. That is probably due to Stan Ackermans, the director of the former IVO (later Stan Ackermans Institute). Many regard his efforts, his vision and his determination as pivotal in the success of the Eindhoven-based programs.
A further influential factor is probably the fact that the programs in Twente and Delft were embedded in the departments from the very beginning. The lack of a central organization makes the existence of the programs much more dependent on the initiative of the professors within the departments. In times of cutbacks this especially can be something that breaks up a designer program. Remarkably, however, the merging of all the designer programs within the 3TU.School for Technological Design, Stan Ackermans Institute led to new initiatives, also in the north of the country.

Led by a new director, former Rector Professor Jack van Lint, the SAI undertakes a path of strategic renewal. Industry is given a bigger share in the SAI cake on all fronts. From this moment on, the institute's executive board comprises a chairman, two internal members and five members, no less, from industry. The structure of the programs also undergoes drastic change: for every student the entire second year of the study will be a company assignment. The respective companies pay several tens of thousands of guilders for this. SAI also gets its own budget to spend, which enables greater freedom to realize its policy. To boost the intake, the institute will focus more than ever on internationalization.
Indeed, in the years that follow the share of foreign talent in the programs rises considerably. Industry also reacts positively to the added value of the designer programs.
Yet the increase in overall intake fails to meet its targets.

BACK TO THE DEPARTMENTS

In 2002, two years after the thousandth degree was awarded in Eindhoven, the Executive Board of the TU/e decides to restructure the SAI again. The institute has a financial shortfall and the introduction of the Bachelor-Master structure also requires a repositioning of the two-year programs. The number of ten programs is cut to eight and the SAI bureau is closed down. However, a virtual institute with a director and coordinator is retained specifically with an eye to student recruitment. Certain training in non-technical skills remains centrally funded while the funding responsibility for the programs is put in the hands of the respective departments.
The decision prompts criticism within the university. It is feared that certain programs will silently die due to the lack of a strong, central organization. An unfounded fear it appears in retrospect. Within the departments there is sufficient enthusiasm for keeping the programs.

2002
Decision to restructure. SAI becomes a virtual institute. Financial management returns to the departments

2003
Sector plan for Science & Technology: three Dutch universities of technology want to join forces

2004
Graduate designers gain a new title, Professional Doctorate in Engineering (PDEng) replacing Master of Technological Design

2005
Presentation of the 2500th designer degree in the Netherlands

THREE TU'S JOIN FORCES

The introduction of the Bachelor-Master system at Dutch universities will later have an impact on the SAI. The Eindhoven, Delft and Twente universities of technology present their Science and Technology sector plan in 2003. This contains proposals for a better harmonization of their Bachelor programs and the establishment of a joint graduate school for Master programs. The idea is to make the TU's more attractive and enable students to more easily transfer to a Master at one of the other TUs after they complete their Bachelor. The universities also want to combine their two-year designer programs. In 2006 the programs are finally brought under the flag of the 3TU.School for Technological Design, Stan Ackermans Institute.
At that point in time TU/e offers eight designer programs, TU Delft offers two while the University of Twente has just ended the final designer program. In total, some two hundred people are following the programs, a hundred and fifty of whom are in Eindhoven. Joining forces gives new impetus to the institute. In 2010, when the three thousandth designer degree is presented, the entrepreneurial spirit is effervescent.
Within all three universities there are plans to set up new programs. The institute gains a highly international character and attracts talented students from all over the globe. Industry, too, is enthusiastic about the programs.
During an interview for the Eindhoven university paper, Cursor, SAI director Professor Kees van Hee points to the money and energy put in to the designer programs by the Dutch government, industry and the universities over the past 25 years.

If you tot up these amounts, you get to a figure of around 300 million euros! That's the amount invested in innovation in the past 25 years. It's a hidden budget that does not appear in any statistic. (Cursor September 23 2010)

Viewed as such, what had been the 'supernova in the academic firmament' has become a tool for innovation that cannot be ignored. Stan Ackermans can count himself pleased.

2006
3TU.School for Technological Design, Stan Ackermans Institute is now official

2010
Presentation of the 3000th designer degree in the Netherlands

2011
Designer programs have now been running for twenty-five years

2011
Five new programs get under way

‘How it works’ is more relevant to an engineer than ‘how it is’. (..) We can then better realize the importance of a broad, multidisciplinary approach and disciplines like economics and ergonomics. Capability is more than knowledge and construction more than analysis (Stan Ackermans, ‘School and Engineering’, in: The Engineer, nr. 4, 1986).

Stan Ackermans (1936-1995)

Capability is more than knowledge

Select the best students using a strict selection procedure; merge the technical colleges and engineering universities, and replace examinations with progress checks. Mathematician Stan Ackermans was full of educational ideas, some of which are still controversial to this day and others way ahead of their time.

At the start of his career, when he came to the Eindhoven Department of Mathematics to do his PhD in 1961, Ackermans stood out due to his ‘extraordinary educational qualities’. His colleague, Professor Jan de Graaf, vice dean of the Mathematics department, had this to say in 1995:

‘The above average number of good results from the students in his instruction groups especially caught the eye. (..) His captivating personality and charisma helped to bind students and staff to him and gave them a strong sense of indebtedness. This bond was often so strong that the students would work hard spontaneously and with an inner passion.’ (Cursor March 23 1995)

The image his colleagues had of him as a teacher – erudite, motivated, inspiring and committed – fits in with the innovative educational vision that he frequently revealed in his lectures and essays. Teachers, Ackermans suggested, must not unilaterally fill their students’ heads with knowledge. Studying should be an active process, a Socratic adventure in which students and teachers engage together. The ideal teacher does not provide ready-made answers but encourages the students to search for solutions themselves.

This kind of teaching requires the necessary effort, qualities and ambition from both teacher and student alike. Ackermans detested mediocrity. He felt that students who were content just to pass did not belong at the university. In the 1980s he openly complained of what he considered to be an increasing degree of a 'school-like attitude' at TU/e. He even called for the discontinuation of student recruitment, arguing that the capabilities of most new students were simply inadequate.
If it were up to him, eighty percent of them would go somewhere else to study: "Higher education for all may well be a task to fulfill for the Netherlands but then leave Eindhoven out of this equation." (Cursor December 21st 1989)

The rigorous selection method Ackermans was proposing may well have been over the top. However, his vision of the learning process as an active quest by ambitious students supervised by a committed teacher set a very important stamp on the Eindhoven designer programs he helped to get off the ground in the 1980s.

VON HUMBOLDT PARADOX

"Generalists know nothing about everything and specialists know everything about nothing," Stan Ackermans wrote in 1986 in the journal The Engineer (nr. 4, April 1986). According to him, engineers are neither specialists nor generalists. "They are integrators, people that can oversee, make connections and yet know exactly how every component functions. Engineers also have to know how we get knowledge and ideas."

Dutch engineer programs in the 1970s and 1980s were too analytical and too little geared to application for Ackermans' taste. Not only should students take a more active part in research and design processes but they should also acquire more social and communicative skills. If it were up to Ackermans, students would learn to look beyond the horizons of their own disciplines and take account of the needs of industry.
To educate students to become the versatile integrators he had in mind, Ackermans claimed that a new educational structure was needed. It must be based on what he referred to as the Von Humboldt paradox. Wilhelm von Humboldt was a reformer of higher education institutes in Berlin in the nineteenth century. He introduced the unity of education and research based on the notion that students learn most when they are taught by experienced researchers.

The paradox that Ackermans often talked about concerns the frequent tension between education and research within the same institution. If they want to improve, the education institutes have to boost their research. In the case of engineering programs, the same applies to design. To improve engineering education, Ackermans argued that a designer and researcher mindset had to saturate the education. Creative designers with a calling for education needed to be employed to make this happen.

BENEFITS OF SECOND PHASE

In the 1980s university programs were shortened. After a first phase of four years students would be able to specialize in a two-year 'second phase'. Hidden in this second phase lay a possible benefit. The need to substantiate a post-master program gave Ackermans the opportunity to put his educational ideas into practice. The designer programs, of which he had been the driving force, embodied the 'learning by doing is better' ideal right from the very start. Also a focus on a broad education, interdisciplinarity, communication and social skills, things which Ackermans considered so important, gave the Eindhoven designer program a distinctiveness that similar programs did not have.
The mathematician was never satisfied; right up to his death in 1995 he continued to strive for a better fit between the designer programs and the needs of industry. As far as he was concerned, industry should contribute even more funding to the programs. These convictions would be rewarded from the second half of the 1990s. Students in the current designer programs spend almost half of their time working on internal design projects in industry. The talented, broadly educated designers are so in demand among industry that companies invest a lot in their education. After all, capability, as industry knows, is more than knowledge alone. Twenty-five years after the institute was founded, that insight is still valid.

The designer programs of the Stan Ackermans Institute have been created in close collaboration with industry. They respond to the current needs of the high-tech sector. The Professional Doctorate in Engineering degree gives designers an important advantage over their Master's colleagues.

PDEng: engineer +

Our society is confronted by major challenges. Ageing demands innovative solutions to the rapidly growing demand for care. Exhaustion of fossil fuels compels us to seek new, sustainable sources of energy. Our pursuit of ever faster means of communication and unbridled mobility forces us to make pioneering modifications to our infrastructure. Technological innovation is an essential component in tackling these challenges.

Implementing new technologies requires much more than engineering insight alone. Our industry needs experts to bridge academic invention and industrial application; people that not only have thorough knowledge of their field but are also used to looking beyond the horizons of their own discipline. Industry calls out for professionals able to put technology in a societal context. For people with considerable experience in the field of project management and planning. This is the added value that graduates of the two-year designer programs at the Stan Ackermans Institute can offer.

ENGINEER +

The Professional Doctorate in Engineering (PDEng) points, as it were, to an 'engineer plus'.

The extra baggage that PDEng candidates acquire can be compared with the knowledge and experience that 'normal' engineers gain only after a number of years working in a company.

A designer program can accelerate careers. SAI graduates can start off as top designers at once.

All PDEng programs are created in close collaboration with the Dutch high-tech sector. Companies like Philips, Shell, Océ Technologies, Akzo Nobel, Dow-Chemical, Ericsson, DSM and ASML have been enthusiastic partners of the institute for many years.

DESIGN PROJECTS

PDEng candidates are paid to learn. They are employed by the university. From the start they are involved in various industrial design projects in a multidisciplinary environment. In the first year the candidates work a lot in groups on these projects, taking on different roles in order to gain insight into industrial practice. During this same year they also follow theoretical classes to broaden or deepen their engineering knowledge. A curriculum that is customized to their personal knowledge and experience enables them to benefit the most from the university's education. There are also joint courses in the area of project management, project planning and social skills.

In the second year the participants undertake an individual, large-scale design project at a company. The project focuses on results. It must not only be innovative but must also respond to the real needs of the customer who pays five thousand euros a month for this. “Five thousand euros a month is little compared to the cost of hiring in a commercial engineering firm,” Professor Kees van Hee, director of the SAI, says. “What's more, we offer the support of an academic staff of top experts, not something the ordinary engineering firm has at its disposal.”

WELL SPENT

Practice teaches that those companies that have taken part in these projects look back on them with great satisfaction. “The graduation projects are not without obligation: our PDEng candidates must focus on projects that deliver,” says Professor Ward Cottaar, director of the Design and Technology of Instrumentation program. “The company quite obviously wants to see its money well spent. The vast majority of the companies connected to our program is hugely satisfied with the end project results. That is also evident from the fact that more than half of the candidates get a job offer from the company upon completion.”

STRINGENT SELECTION

The selection procedure of the Stan Ackermans Institute is very tough. To participate in the program a relevant Master degree is required along with the necessary motivation.

To guarantee top quality in the programs, the CCTO, the Netherlands Certification Committee for Technological Designer Programs, sets very strict program requirements.

PROGRAMS IN EINDHOVEN

Architectural Design Management Systems (since 1996)
Automotive Systems Design (since 2011)
Design and Technology of Instrumentation (since 1991)
Information and Communication Technology (since 1988)
Logistics Management Systems (since 1988)
Mathematics for Industry (since 1989)
Process and Product Design (since 1989)
Software Technology (since 1990)
User System Interaction (since 1998)

PROGRAMS IN DELFT

BioProcess Engineering (since 1994)
BioProduct Design (since 2006)
Comprehensive Design in Civil Engineering (since 2011)
Process and Equipment Design (since 1991)

PROGRAMS IN TWENTE

Civil Engineering (since 2011)
Energy and Process Technology (since 2011)
Robotics (since 2011)

FROM ICT TO ROBOTICS: SIXTEEN DESIGNER PROGRAMS

The 3TU.School for Technological Design, Stan Ackermans Institute offers sixteen programs spread across the three universities of technology of Eindhoven, Delft and Twente. Since the beginning most of the programs have been concentrated in Eindhoven.

Incorporating all the programs within a 3TU-wide institute in 2006 provided the programs with new momentum. At the beginning of 2011 the bell sounded for the start of at least five new designer programs, one in Eindhoven, three in Twente and one in Delft.

INTERNATIONAL AMBIANCE

The award of the three thousandth designer degree to a Greek PDEng candidate in 2010 illustrates the high percentage of international talents in the designer programs. Currently more than three-quarters of all PDEng candidates comes from foreign countries. Alumni often look back enthusiastically at the international atmosphere that characterizes the programs. Contact and cooperation with people from different cultures is considered an enriching experience by most of them.

PDEng candidates from outside the Netherlands get to know local corporate cultures during their program, which helps them to find their way on the Dutch work floor after they graduate. In their turn, Dutch participants get an opportunity to experience intercultural cooperation in their own country.

Sissy Papatheologou from Greece receives the three thousandth PDEng designer degree on September 16th, 2010.

Mathematics for Industry

The Mathematics for Industry (MI) program trains students to use their mathematical skills to solve industrial problems. The program has roughly three areas of application: communication and information processes, engineering, and logistics processes.

An MI expert may, therefore, just as easily look at the problem of blend ratios in the chemical industry or deal with datacompression for image-processing systems. Even the design of hospital planning to reduce the waiting time for patients would be an excellent focal area for the MI specialist.

It helps to have a broad perspective when analyzing industrial problems to arrive at mathematical solutions. “Our trainees work within a multidisciplinary environment and have to be prepared to delve into completely different fields,” says Dr. Stef van Eijndhoven, director of MI. “That requires communication and quite a bit of flexibility, which is why the program concentrates so much on personal development and broadening the engineering horizons of the students.”

The program has been cooperating in recent years with a range of companies such as Océ, Heineken, Tata Steel, Dow Benelux, Deloitte, Ewals Cargo and Philips Healthcare.

Since: 1989

Number of graduates until 2010: 229

The MI program is part of the Eindhoven department of Mathematics & Computer Science

www.3tu.nl/sai/mi

DANIEL SIREGAR
MSc, PDEng (2006 - 2008)

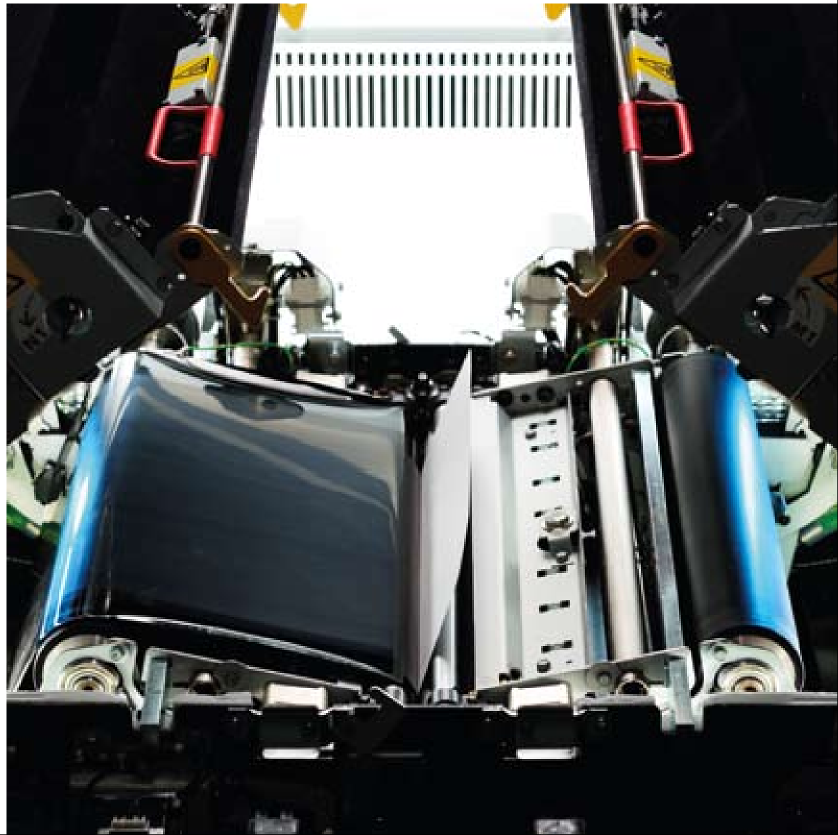
‘The program has broadened my mathematical horizon’

MODELING PRINTER BELT CONTAMINATION IN INDUSTRIAL LASER PRINTERS

‘What attracted me to the program was the bridge between mathematical theory and industrial application. Engineers often work with ‘trial and error solutions’. They try something out and if that doesn’t work, they look at something else. Mathematicians analyze the problem in greater depth but often create solutions that are difficult to apply in practice. At MI you learn to look for fundamental solutions that can also be used in practice.

I did my design project at printer manufacturer Océ. The project concerned industrial laser printers in which a belt revolves constantly. First an image processing unit puts the toner in the right position on the belt. Then the belt revolves under a roll of paper that is heated there and then such that the toner is compressed on to the paper. Then the belt goes through a cleaner that removes the residual toner so that the whole process can begin again.
Paper always contains a very small amount of wax. When heated the wax melts and a very small amount is left on the belt. The cleaner removes only part of this. Where the wax remains on the belt, the toner will no longer adhere properly. In time this may cause damage to the Image Processing Unit, the most expensive component of the printer. So the belt needs to be replaced at the right moment.
I developed a model that describes how the wax spreads over the belt. Then I created a simulation program that could accurately predict within a few minutes the contamination on the belt after many print runs.
The program that Océ had been using until then required a whole day to simulate just one print run. My program is now being used by Océ and other SAI trainees are working on an extension to this.

Within the academic world, the process of knowledge development tends to be central. By contrast, companies are more interested in input and output. My supervisor also wanted to see results. In the beginning I had problems dealing with that. How could I, as a mathematician, explain what I was doing without talking in terms of differential equations? During the course of the project I learned to translate the application of mathematics into comprehensible language. That is also essential.
This program really extended my mathematical horizon.’



Wax cleaner roll in fuse-unit printer.

BioProcess Engineering

The BioProcess Engineering (BPE) program concerns the development of new processes to make biochemical products. These processes could often be faster, cheaper and more environmentally friendly. Examples include replacing oil with vegetable materials to make chemical products or improving biofuel production processes.

PDEng candidates learn to look in detail at every stage in the production process. Is the process economically profitable and what is the environmental impact of it? What is the most suitable purification method for separating by-products? “The clear added value of BPE experts is that they thoroughly understand all the ins and outs of the design of production processes,” Yvonne van Gameren, MBA, coordinator of BPE, says. “Their design experience gives them greater insight into the industrial context of the process. What’s more, they can model those processes in detail.”

BPE trainees are much in demand as experts among a large and very varied group of companies. Heineken, DSM, Crucell, DSTI, Fujifilm and Purac are some of the companies where they have undertaken design projects in recent years.

Since: 1994

Number of graduates until 2010: 79

The BioProcess Engineering program is part of the Delft department of Applied Sciences

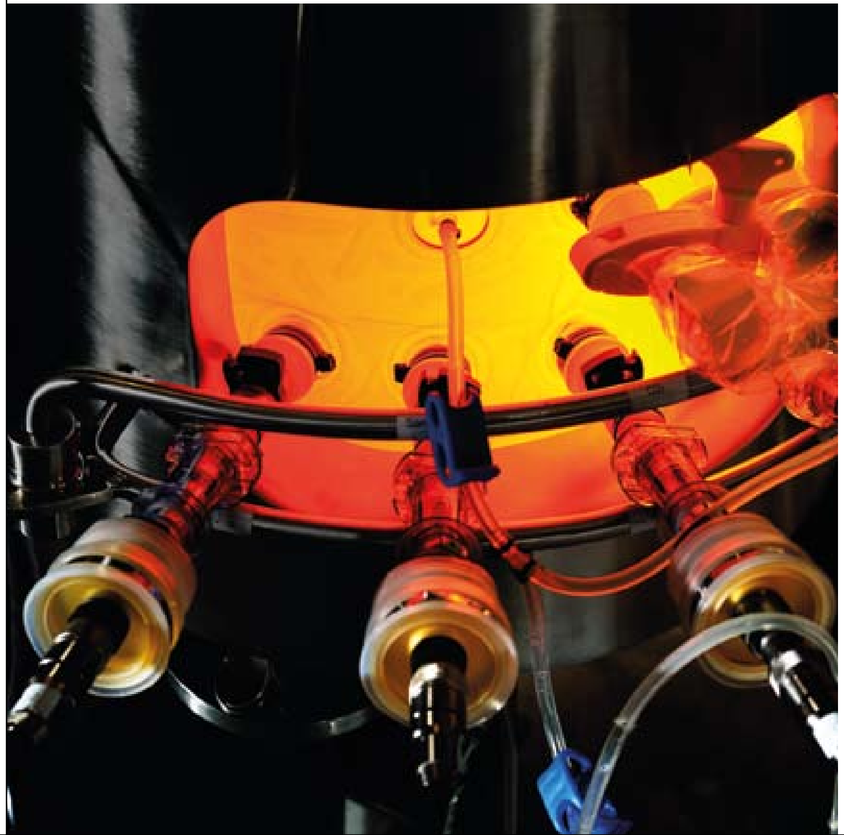
www.3tu.nl/sai/bpe

OLALLA GUERRA MIGUEZ
MSc, PDEng (2008-2010)

‘This study has brought together my main interests’

PURIFICATION PROCESS OF TUBERCULOSIS VACCINE MADE TRANSPARENT

‘Following high school, I was stuck for choice between two studies: chemical engineering and medicine. I went for the first option but then discovered that life sciences attracted me a lot. The BioProcess Engineering program gave me the chance to steer my career in the direction of where my interests came together.
My design project took me to the pharmaceutical company Crucell, in Leiden, which develops and produces vaccines and antibodies to combat and prevent infectious diseases like malaria, influenza, HIV and tuberculosis. One way of producing a vaccine is to add the virus you are trying to combat to human cells in a bioreactor. The virus will multiply in the cells. To then retrieve the virus from the reactor, all the cell material must be removed.



My project centered on this purification process for a tuberculosis vaccine, especially the removal of the DNA material from the cells. This can be done adding certain ‘agents’ to the reactor. The agent will bind to the DNA material, causing it to precipitate to the floor of the reactor. It is also possible, however, that a part of the agent will bind to the virus. In this case you lose your product, something you clearly want to avoid.
Within the company it was known, more or less, what the reaction time was and how much added agent made for the best purification result. However, this was based on ‘trial and error’ and nobody knew which reaction mechanism was actually responsible. My assignment was to unravel this reaction mechanism. To this end I undertook all kinds of experiments like measuring using a microscope how the dimensions of the precipitating materials changed over time. This provided essential information on the course of the reaction process.
Based on these experimental data I developed a theoretical model that predicted the exact course of the purification process as a function of all kinds of variables. We are now engaged in using the same knowledge for the purification of other kinds of vaccines.

Following my studies I stayed on to work at Crucell. While I had not imagined I would end up working at a pharmaceutical company, I am really happy that I got such an opportunity. As a chemical engineer in Spain, where I come from, my career would have turned out quite differently. I would have been predominantly focused on theoretical equations. Now that I combine my knowledge of chemistry with life sciences, my work is much more challenging and interesting.
And every day I learn a little more.’

A bioreactor for 50 L scale in USP pilot plant at Crucell biotech-company. The precipitation is done in this bioreactor.


Bhaskar PATIL
Jorge Andres
Moncada Escudero

Design and Technology of Instrumentation

What might you imagine the Design and Technology of Instrumentation (DTI) program is all about? Colossal dredgers with a system that measures the quantity of sand in the seawater that is pumped up? Mats with smart sensors able to register the heartbeat and breathing of premature babies?

These are among the subjects you will find within the field of the DTI student. The program produces top designers for a very wide range of industry. The crux lies in complex measuring technologies.

“Affinity with physical modeling methods and a results focused disposition are the key criteria for participation in the DTI program,” Professor Ward Cottaar, director, explains. “You will be designing things that lead to a tangible industrial application. Typically around a quarter of all our DTI candidates ultimately also does a PhD on design. They are not employed by the university but by the company that needs the design.”

Most trainees are offered a job at the company where they do their end project after completion. The program works with a very varied range of large and small industrial partners. In recent years these have included Shell, Philips, TNO, Bradford Engineering, PIE Medical, IHC and NXP.

Since: 1991

Number of graduates until 2010: 109

The DTI program is part of the Eindhoven department of Applied Physics

www.3tu.nl/sai/dti

GERRIT OOSTERHUIS
PDEng, PhD (2002 - 2004)

‘I learned mainly to look beyond the horizons of my own field’

ELECTRIC OUTBOARD MOTOR FOR SHIP MODELS

‘In Wageningen I studied ‘environmental physics’, a kind of applied physics in which I specialized in experimental meteorology. However, what I thought would be great was to make and design things, applying physics to an actual apparatus. I heard by word of mouth of the Stan Ackermans Institute. This program would enable me to make the step towards design and, moreover, boost my engineering knowledge.
At the beginning I felt a bit lost; I had to draw up my own educational plan and choose from a host of subjects. But that prompted me to take control. The program encouraged me to seek more width than depth, which led me to become familiar with all kinds of unknown disciplines. And I certainly benefited from this: today, as a system designer at TNO, it is very useful to have an understanding of different disciplines.
I wanted to carry out my design assignment in the vicinity of Wageningen, where I lived at the time. I had heard from others about MARIN, a research institute that undertook measurements for the maritime industry. After an initial introduction, we looked at subjects that could be appropriate for both me and the company. My design project ultimately focused on a scale model of pods, the electric outboard motors for ships. Many ships are powered by pods, which contain an electromotor and are also used to steer. Enormous generators on cruise ships cater to the onboard electricity needs during the day while the electricity is used at night to power the ship’s propulsion. The sophisticated streamline of the pods makes the drive very efficient.

The scale model of the pods used by MARIN until that point to perform measurements deviated quite significantly from reality. The motor was in the ship model itself whereby a driveshaft drove the pod. Moreover, the set-up caused all kinds of vibrations and forces that distorted the measurements, so I had to develop an alternative concept.
It took me a lot of time to list all the specifications of the design. The package of requirements by MARIN was so broad that the design I had to come up with was a near impossibility. So first of all, I made it very apparent that different kinds of tests required different kinds of propulsion. Eighty percent of the tests could be done using three design options, one of which I detailed during my design project and a second during my PhD that followed.

The cooling had been a problem in the model’s electromotor until that time; my model used the water around the pod to cool the motor. It was also quite a challenge to match the specifications of our components with those of commercial suppliers. The motor we were using, for instance, would not be robust enough to withstand the load in an industrial environment. This initially appeared to be a stumbling block until we discovered that this was fine for a test environment. The design has since become ‘common technology’.
One of the main things I learned during the program was to look beyond the horizons of my field. It’s a way of discovering that you are capable of much more than you might imagine. I also try to instill this in the trainees that I now bring in from the SAI. I enjoyed the program so much that it’s fun to still be involved in this way with the institute. At TNO I know several people that have followed a program at the SAI. They all make a mark within the organization, which says something about the institute and the people they educate.’

MARTIJN VAN RIJSBERGEN
MSc, MARIN, Specialist Measurement Quality

JAN TUKKER
PhD, MARIN, Project Manager Measurement Systems

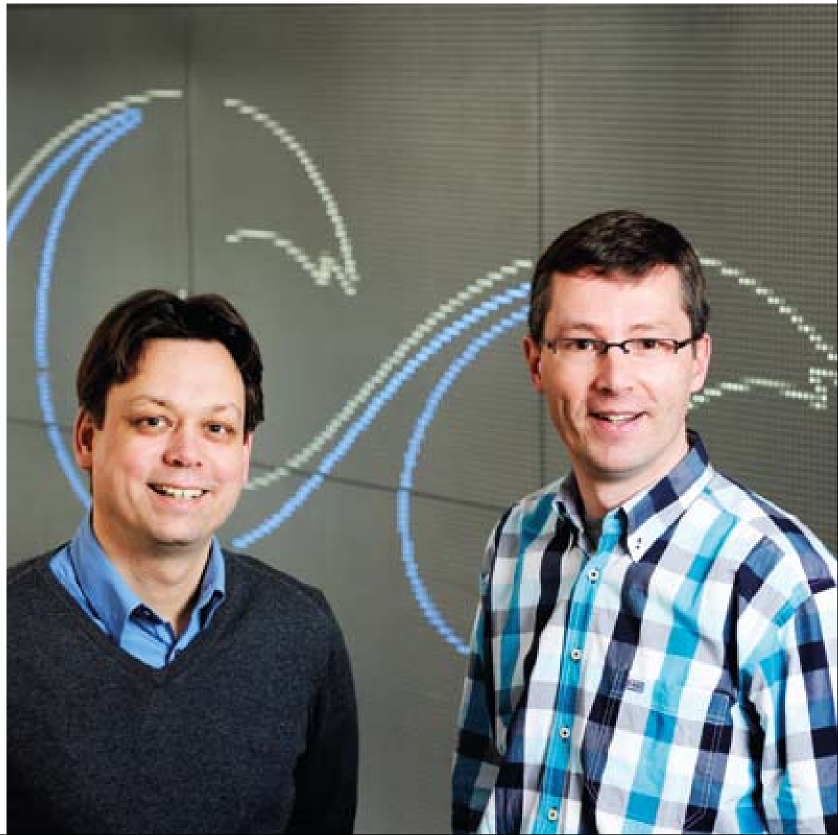
‘Matching all the criteria demands plenty of design creativity’

‘The shipping industry charges MARIN with research into new designs for ships and their components. We usually build a scale model of the real design so that we can perform all kinds of measurements. The pod originates from the 1980s and MARIN was one of the first institutes to build scale models of them.
The most commonly used scale model then comprised a motor on the inside of the ship model that propelled the pod via a right-angle transmission, which caused many an inaccuracy in the measurements. At a certain point in time a propeller manufacturer came up with a design for a strut (connecting the motor housing with the ship) with a non right-angle shape. Due to our right-angle transmission, we were unable to give the scale model precisely the required shape, so Gerrit’s design assignment hit on a very real commercial problem.

When Gerrit and his supervisor, prof. Herman Beijerinck, knocked on our door, we were quickly enthusiastic. The MARIN management team was somewhat hesitant, however, since the Stan Ackermans Institute was an unfamiliar quantity. Beijerinck then showed real entrepreneurship by applying a lower entry-level price for the first year, which managed to get MARIN over the line. Throughout the project, too, the close involvement of Beijerinck was crucial to progress.
Gerrit came to us as a very shy young man but we saw him grow as a communicator. He was certainly an excellent independent worker and a very analytical thinker. At the same time he was hands on and worked really hard to get the things he believed in going, which made him a perfect fit for our development department.

It was vital for us that the components for the design were commercially available. If one of them became damaged or broke, it meant we could easily get a replacement. Matching all the criteria with materials available on the open market demands plenty of design creativity. That made the project so challenging.
One afternoon Gerrit was sitting in his office pulling at his hair. He said, ‘I can’t do it all!’ It’s a good job that he continued with a list of design alternatives. Previously we had various people who wanted to do everything, and that resulted in nothing being done.
At the end of his traineeship he had taken the first measurements on his design. His PhD gave him the opportunity to go further with his design. His thesis was published and allowed other institutes to use his design principles. However, we have already extended the concept with a sensor to measure all the forces and moments on the propeller. We like to be just that bit ahead of the rest.

The good thing about the DTI program is its focus on results. Master students at the university are generally geared to a scientific question. Trainees from the SAI, on the other hand, have to achieve something more tangible, an objective that fits in well with the MARIN vision.’




Simon Chen

BioProduct Design

The particular focus of the BioProduct Design (BPD) program is the development of products based on biological systems and everything that includes. It may be a new hepatitis B vaccine that is more suitable for a broader market. It could also be the development of degradable plastic, produced from wastewater.

These are areas in which BPD designers typically apply their expertise. The BPD projects are mainly geared to the biotechnological and pharmaceutical, food and chemical industries.

“The added value of BPD experts is hidden in the fact that they can place products and their production processes in a broader perspective,” says Janine Kiers, MA, coordinator of BPD. “They look not only at the product itself but are also able to make an economic evaluation. What raw materials are necessary, what is the product’s target market and who is intellectual property owner? They make sure that scientific innovations are implemented according to industry requirements. In short, they make the step to actual innovation.”

Almost all BPD students have found their way into a job before graduating, some of whom at the company where they carried out their individual design project. Industrial partners like DSM Biologics, DSM Food Specialties, Crucell, Sanquin, FrieslandCampina, Paques and many others have worked successfully with the program.

Since: 2006

Number of graduates until 2010: 6

The BPD program is part of the Delft department of Applied Sciences

www.3tu.nl/sai/bpd

MENG LIU
MSc, PDEng (2008 - 2010)

‘I have learned to look at technologies from a business perspective’

NEW METHOD OF ENZYME CLEANING FOR THE FOOD INDUSTRY

‘Following my Master in Biotechnology in Denmark, I wanted to gain more experience within the industry, and the BioProduct Design program offered such an opportunity. I found the non-engineering subjects during the first year especially interesting. A subject like ‘Turning Technology into Business’ encourages you to look at technologies from a business perspective. And I’m still benefiting from this in my current job.

I did my design project within the Food Innovation Center of DSM. It was a large project that also involved Wageningen University, Friesland Food Campina, BAC BV and TU Delft. I had to present my results every two months to all the partners, something I found very exciting. DSM has a new technology to purify enzymes for the food industry.

Enzymes enable all kinds of chemical reactions in which they are not consumed themselves. In the production of specific food enzymes, however, all kinds of unwanted enzymes are generated as by-products. These have to be separated from the required enzyme. The new method of purification, ‘affinity chromatography’, is already used in medicine. My assignment was to find out whether the method could also be used affordably in the food industry.
In affinity chromatography the solution that has to be purified goes through a glass column filled with tiny polymer globules. ‘Ligands’, proteins that affix exclusively to unwanted enzymes, attach. When the solution flows through the tube, these enzymes remain behind while the required enzymes leave the column. The column is then cleaned using buffer fluid so that it can be used again.
Up to that point DSM had been using a purification method based on a very opposite principle: the required enzymes were bonded to the polymer globules in the column. The concentration of contaminated enzymes, however, is much less than the required product; so you need many more tubes for this method. Moreover, the ligand in the new method binds more specifically to the enzymes, which improves the cleaning.
In the first place I explored which kind of polymer globules were most suited to binding the ligand. Small-scale experiments allowed me to calculate how much of the required enzyme remains at the end of the purification process. I was also able to estimate the difference in costs between the old and new purification method.
Unfortunately, the true ligand was not available until the last two weeks of my traineeship. So I had to use a less specific model-ligand with comparable properties, which meant that my calculations still contained some inaccuracies. While my results pointed out that the new purification method is promising, subsequent research will have to confirm this.
For my current job as researcher at Synthon BV my experience in the design project has proven very valuable. I have acquired not only technological knowledge but I have also demonstrated that I am a team player.’

Proteine purification using affinity chromatography, ‘äkta purifier’.

User System Interaction

Modern equipment is not 'finished' just if all the buttons work; the user has to be able to operate it. That goes for a DVD player as much as for complex intelligent systems like electron microscopes and MRI scanners.

The User System Interaction (USI) program delivers experts able to harmonize the 'usability' of such systems to the future user, combining technological knowledge with insight in the field of life sciences and design.

"Many intelligent systems are technically excellent but they can still lack user-friendliness," says Professor Aarnout Brombacher, dean of the Eindhoven Industrial Design department under which this program falls. "Which is why the combination of technology and human sciences is so essential. Nowadays design is also a key component of the program: enticing users to display particular behavior is taking on an increasingly important role in modern equipment. The career ladder of graduates is often steep," Brombacher explains. "That is because they are able to so easily integrate, communicating just as well about the technological aspects as the psychology and design."

The program cooperates with manufacturers of complex intelligent systems (like Philips, Océ, ASML) and of intelligent products for areas like Health & Well-being (like Adidas and Philips).

Since: 1998

Number of graduates until 2010: 202

The USI program is part of the Industrial Design department in Eindhoven

www.3tu.nl/sai/usi

'I bring together people from different blood groups'

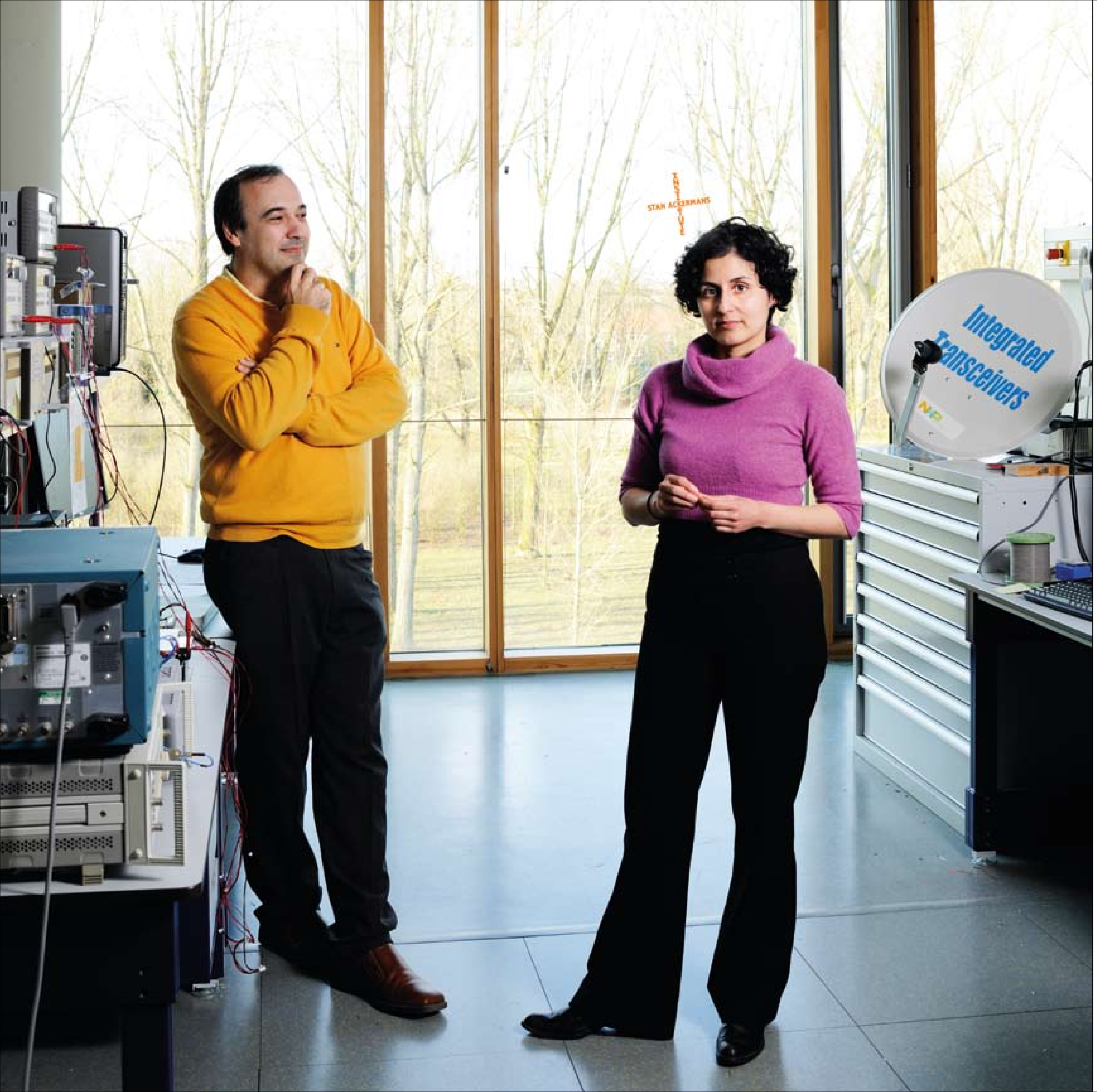
BOARD GAME TO DEVELOP SOCIAL SKILLS

'During my Applied Computer Science studies l discovered how interesting the human side of the field could be. The 'hard' technical side of programming fascinated me less than the way in which people use software. USI fitted my interest well.

MSc, PDEng (2006-2008)

My design project was for Philips Research where they had been working for years on an electronic, educational board game for children. My job was to check out the medium's suitability for the training of social skills. I reduced that broad definition to a single characteristic – shyness – which meant that I was able to link this to measurable behavior.
But since I was not an expert in the development of social behavior among children, I visited a few elementary schools where I spoke with the teachers about the subject. I also read as much of the literature about the subject as I could. Based on all the information, I thought up several games for the electronic platform, detailing one of these.
The 'Playground Architect' game, the prototype for which I had built myself, is for children aged from nine to eleven. Four players build a playground together, putting three-dimensional objects on the playground. One of the children, the most shy, has the role of 'architect'. The architect is informed through headphones of how the playground should look and he or she must then give instructions to the other three players. These are instructions that also force the 'performers' to think.
Once the playground is finished, lights come on. You see that the whole group often cheers at that moment because they have accomplished something together. Most of the shy children said that they had enjoyed playing the boss. And a classical test revealed that even the 'performers' after the game enjoyed playing more with the 'architects' than before.

I did not have the time within my project period to measure the longer-term effects. However, I did scientifically substantiate the plausibility of the platform as a suitable medium for training social skills.
My project has contributed to the development of the 'touch tile', an educative touch board being sold by Serious Toys to educational institutions.
The program gave me a good multidisciplinary basis. I can now sit among designers, developers and user researchers and talk to all of them. It is a really valuable skill to be able to bring together people from different blood groups.'



Information and Communication Technology

The highly diverse design projects of the Information and Communication Technology (ICT) program illustrate the range of the field. Trainees can really get into operating systems for industrial lithography equipment and printers as well as improving image-processing methods for equipment like x-ray devices and MRI scanners.

Or they may focus on the influence of mobile phones on the human brain. Specialization can range from electromagnetism to signal processing and from analog or digital design to power electronics and smart grids.

PDEng candidates in any case acquire skills in designing systems that receive, process, store and transmit data. The program also includes describing and simulating circuit components as well as the design and construction of system components. The interaction between hardware and software is also a focal area.

A special feature of the program is that even before the study begins applicants are coupled to a professor and, where possible, a suitable company on the basis of their personal interests and ambitions. “A coach helps the student draw up an individual curriculum with a specific package of subjects,” says Professor Leon Kaufmann, director of ICT. “The field is simply too wide-ranging to follow the subjects of all the professors. Specialization is necessary to successfully complete the design project.”

The industrial partners of the program include large companies like ASML, Philips (including Research and Health), NXP, KPN and TNO. Assignments have also been carried out for smaller partners like Inviso and Pie Medical Imaging in recent years.

Since: 1988

Number of graduates until 2010: 193

The ICT program is part of the Eindhoven department of Electrical Engineering

www.3tu.nl/sai/ict

'The study suddenly got my career moving'

LESS ENERGY CONSUMPTION AND NOISE IN CHIP

'My physics studies gave me a broad, theoretical background and the work I did in the last years for NXP (still Philips Semiconductors at the time) demanded more specialization in my opinion. Of course, I could open some books and add to my knowledge but I wanted to do it in a more structured way within the context of a study.
In addition to the theory courses, there were also non-technical subjects. Project based management taught me how to plan a project within a company in a very structured way, step by step. I found it useful to establish a timetable and force myself to stick to it. This would certainly be very handy if I were ever to become a process or product manager.
For my current job as researcher the course in technical writing has been very important; no matter how good your research is, its value depends largely on how well you can communicate it.

MELINA APOSTOLIDOU

PDEng (2004 - 2008), Winner of the TU/e Design Award 2008

The design project I did for NXP focused on minimizing noise in chips for satellite dish receivers. A component in the chips of these receivers, the 'phase locked loop', ensures that the required signal is generated. It comprises various blocks, each with its own functionality and each of which causes noise; it is vital that the noise does not exceed the required signal.
One of the blocks within the phase locked loop is the frequency divider. This component not only contributes to the production of noise but is responsible for a substantial part of the energy consumption of the phase locked loop. Various factors affect the production of noise, like the bandwidth of the system, the signal frequency and the power supply. Reducing the energy consumption often causes more noise. Since the system is allowed to consume less and less energy, it was time to get a better understanding of the trade-off between energy consumption and noise production.

In the first place I made a mathematical model with parameters that influence noise production. The model was based on literature an enriched with new parameters like bandwidth. The model makes it transparent how the noise is structured in the frequency divider.
The insights this generated were important to understanding how an existing simulator can be used to predict the noise in the frequency divider. The accuracy and duration of a simulation program depend on the parameters you supply. Although the simulation program already existed, the correctness of the simulation parameters and the calculations had not been properly reviewed. The time required by the simulator for the calculations also had to remain limited. This duration and the accuracy of the simulation are a trade-off that I had to take account of.
To be able to predict the actual noise production of the frequency divider I had to design an experiment to evaluate both my mathematical model and the simulation. The results allowed me to make a design flow that chip designers can use to set up their simulation tool. Now that designers can precisely calculate the noise production of their design, they can incorporate smaller margins and so ultimately reduce the energy consumption.

During my entire study I worked four days a week at NXP. Fortunately, I was able to schedule my study time on a flexible basis, making my own appointments with lecturers and doing most of my study in my own time. I also learned a lot on the job.
The study has given me a respected title on my CV. Initially I didn't think it mattered all that much but it does. Once I had finished my study, my career took off and I got promoted. But, most of all, my study has given me more self-confidence. In previous years it had cost me a lot of energy to find my place in the department. Now I am much more aware of what I am capable of.'

CICERO VAUCHER

PhD, Senior Principal Integrated Radio Frequency Systems, NXP

'Thanks to better simulations, the risk of failure in chips is much lower'

'I was already working with Melina when she came to me and asked what a good design assignment could be for her study. It had to be interesting for her study and for NXP. A bit of puzzling later and we came up with the noise behavior of frequency dividers.
The development of chips for satellite dish receivers is a focal area for NXP. To keep our market leadership our chip has to be not only the cheapest and most energy efficient but must also comply with the very highest performance requirements. Low energy consumption and high performance often conflict and lead to a trade-off in the design.
The noise behavior of the frequency dividers in our circuits was difficult to predict at that time. The simulation tools we had for this did not clearly indicate whether the results were correct. Melina was assigned to investigate and come up with a kind of design flow that could generate reliable results.

Melina was a really good candidate for this assignment. She had all the required expertise in house because she had designed the circuits herself. But it was certainly no easy task. If she had not done this study, I don't know if this project would have got off the ground. We would then probably have continued designing circuits on the basis of what we knew.
All the project's objectives were achieved. The simulation method developed by Melina is now being used in practice. Now that we can better predict the behavior of the circuits, the risk of failure is much lower, which boosts the performance of the satellite dishes.
The method can also be used in other application areas with comparable communication chips. I have already sent the report to many colleagues in other sectors, such as those working with radio and television tuners. They are very pleased with the results.

Cooperation with the TU/e supervisor ran smoothly. It is always fascinating to have contact with university people. I would probably welcome a subsequent SAI trainee with open arms, provided the material matches with our goals, of course. The level of the trainees I came across in other projects was also good.
A study like this helps to acquire skills that you would otherwise not acquire or acquire much more slowly, I believe. Melina has, I think, learned to work more analytically and systematically, much more and stronger than she had done before. The fact that she got a ten out of ten was also a pleasant surprise for me, too, but very deserving: her assignment was very broad. Not only has she done very important theoretical work but she also designed the circuits and a design flow. She worked really hard and really well.'

Architectural Design Management Systems

Major building projects are characterized by far-reaching fragmentation among the participating parties. There are many sub-processes that must successfully match for a satisfactory end result in terms of quality, time and money. If this does not happen as it should, delays, higher costs and minimal quality quickly result.

Design management is the innovative answer to this problem. The intrinsic integration of all the sub-processes at the start of a building project save time, costs and project management. This also helps to monitor the quality. The Architectural Design Management Systems (ADMS) program trains students to become experts in developing transparent and efficient design strategies. This makes it a unique program in Europe.

“ADMS trainees are bridge builders,” says Ad den Otter, PhD, the program’s director. “Large building projects quickly involve ten or so parties. Our experts connect them and create good mutual understanding. If a strategy is developed at the beginning of a building project that matches the various intrinsic building processes, this engenders the quality of the project. There is less risk of misunderstandings, logistical problems and delay.”

ADMS trainees have done their design projects at all kinds of companies and institutions in recent years. These include Architecten Cie Amsterdam, DHV Amersfoort and Eindhoven, Institute Verbeeten Tilburg, ING Real Estate Den Haag, Zri and SCS Den Haag, Brink Groep Eindhoven, ATP Innsbruck and Atrivé Utrecht.

Since: 1996

Number of graduates until 2010: 78

The ADMS program is part of the Eindhoven department of Architecture, Building and Planning

www.3tu.nl/sai/adms

ROY PYPE
MSc, PDEng (2004 - 2006)

‘The program acted as a kind of pressure cooker’

BUSINESS PLAN FOR RADIOTHERAPEUTIC HOSPITAL SATELLITE LOCATIONS

‘New architect graduates believe that everything is possible if it is architecturally feasible. Certain projects during my study suggested that this does not always work out in reality. Projects often fail due to funding or conflicts of interest. So after completing my architectural studies in Leuven I wanted to find out more about the design processes. In the first year at ADMS we undertook two complex case studies, in which we analyzed entire building processes. It would have taken me between two and six years at a firm of architects to gain the same level of experience. So the program acted as a kind of pressure cooker for my career.

I did my final design project for the Institute Verbeeten in Tilburg, a classified hospital for radiotherapy. The institute was on the point of placing satellite locations at hospitals in Den Bosch and Breda to improve oncological services. While many hospitals have in-house facilities for chemotherapy and surgical intervention, expensive radiotherapy facilities are often absent. So there were plans to build satellite locations elsewhere in the future also. I was given the assignment to develop a real estate strategy for this. Ultimately, I also described the financial framework for the strategy, which resulted in an actual business plan.

The changed financing structure of hospitals had an impact at that time: real estate expenses were no longer reimbursed by the government so the institute wanted to check whether the real estate plans were financially viable.

In drafting the real estate plan I considered all kinds of aspects. What legal procedures were involved, what is the allowable budget, what functionalities must the rooms have, what can be generically established and what must be determined per location, what does the design process look like?

I also placed the plans in a broader context. Two factors are essential to the success of the project. Firstly, the ICT and automation between principal and subsidiary locations have to be right. Secondly, the intrinsic cooperation between the radiotherapists and specialists have to be very good. No matter how well you organize your real estate, if the medical staff dig in their heels and object for some reason, the building can still be cancelled. So there also had to be a blueprint for the medically intrinsic cooperation. That is not something that I can set up as an ADMS trainee but I can emphasize the need for such a blueprint.

A building project is often also a change project. This puts pressure on the relationships between the parties involved, all of whom have their own vested interests. Infighting can even occur about who has his own entrance in the new building. These are things that cannot be ignored.

The satellite location in Breda has since been built and that in Den Bosch is under construction. I have been appointed by the firm of architects responsible for the building as project leader for the whole process. I consider it a tremendous gift to have the opportunity to see an entire project grow from a germ to a flourishing plant.’

Institute Verbeeten, location Breda.

Process and Product Design

Can we convert fossil fuels into materials with a high added value? Is there a way of converting carbon dioxide into usable products? If so, what technology do we need and what will that give us in terms of sustainability and economic return?

The answer to such questions requires top-level expertise in chemical and process technology as well as insight into project and financial management. The Process and Product Design (PPD) program produces specialists that fulfill these very requirements.

The program concentrates on the chemical and food industries as well as industrial sectors in which plastics technology is central. “Our students learn to develop innovating concepts for the process industry and apply these directly to practical situations,” says Professor Jan Meuldijk, scientific director of the program.
“Our designers are highly valued by industry, making a flying career start. With the experience gained in the program they rapidly grow from their first job to a key technological position.”

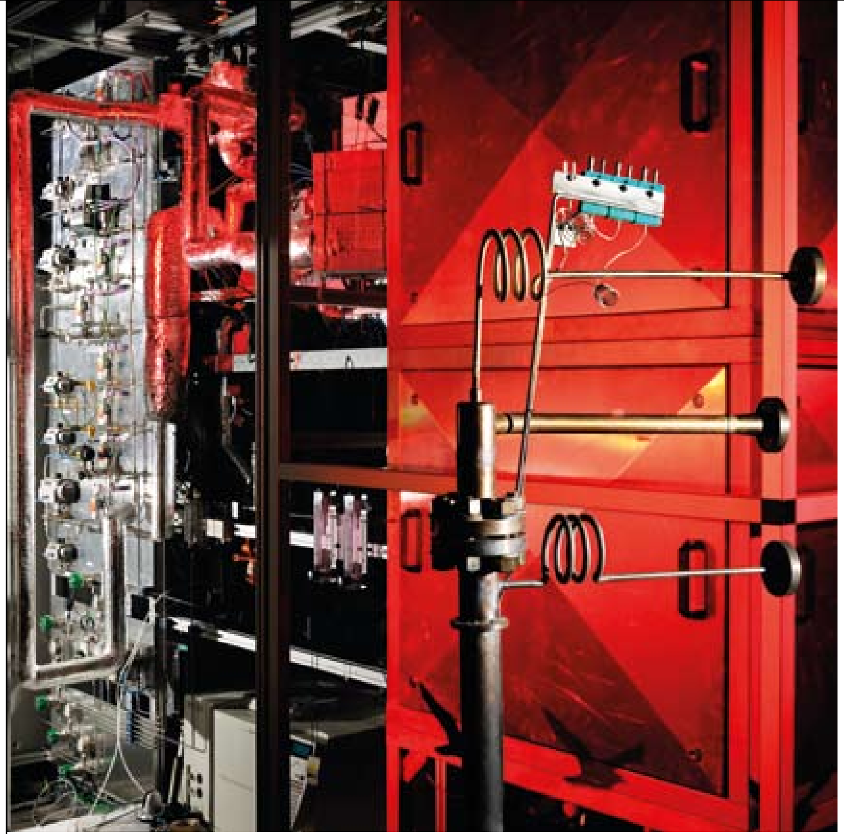
The program works with many companies such as Akzo Nobel, DSM, BioMCN, Sabic, AVeBe, SaraLee/DE, Unilever, Purac, Friesland Foods and the Energy Research Center of the Netherlands (ECN).

Since: 1989

Number of graduates until 2010: 284

The PPD program is part of the Eindhoven department of Chemical Engineering and Chemistry

www.3tu.nl/sai/ppd



Membrane reactor test setup at ECN.

‘I wanted to get more from my career’

MEMBRANE REACTOR FOR CARBON DIOXIDE CAPTURE

‘I had been planning to gain some international experience for a long time. In Spain there are few jobs at the level where I am now; I could not have reached my current level if I had started working straight after graduating. I wanted to get more from my career than fellow students in Spain.

FRANCISCO ZARAGOZA MARTIN

MSc, PDEng (2007 - 2009), Winner of the TU/e Design Award 2010

An important advantage of the PPD program was that I could gain experience in different sectors of the chemical industry, which gives me more options than the petroleum industry, my original focus.
If, for example, I want to move to the production of plastics, I can.

My design assignment was for the Energy Research Center of the Netherlands (ECN). I modeled and designed a certain type of membrane reactor to investigate whether this would be suitable for the capture of carbon dioxide in electricity power plants. Generating electricity from fossil fuels is responsible for a third of all the carbon dioxide emissions caused by man. However, nearly all the carbon dioxide can be captured using membrane reactors. This generally happens in two stages: the methane gas that flows into the reactor reacts with steam to produce hydrogen and carbon dioxide. The hydrogen is then separated from the carbon dioxide after which it can be used to generate energy. The carbon dioxide is subsequently transported away to be stored underground.
I studied a new membrane reactor concept in which both stages occur simultaneously, a process that could be more efficient and thus cheaper. The reactor has a ‘feed side’, a space into which the methane gas flows in and the carbon dioxide and water exit. This feed side is connected via a thin membrane to a second space, the ‘sweep side’. The hydrogen that is released in the first space flows via this membrane to the ‘sweep side’ where part of the hydrogen reacts with oxygen, thereby releasing heat. This heat can be used directly for the reaction in the feed side.
The problem in this concept is that the membrane, a thin metal layer on a ceramic tube, can become damaged by the heat. The amount of heat created depends on the quantity of oxygen added to the hydrogen. The supply must occur as gradually and constantly as possible throughout the entire space.
I developed mathematical models that describe what happens in the reactor: the mass and heat transfer, the heat production during the reactions and the membrane transport. I then came up with a reactor design in which a constant air supply ensures the least possible local heat production peaks.

My design won the TU/e Design Award 2010 but it never got into production. Other concepts studied appeared to offer more advantages. My program gave me more than the career boost I sought. For instance, I found it really inspiring to work with people from around the world on a daily basis. I tell everyone in Spain: the experience you gain abroad more than makes up for the pain of leaving.’

Logistics Management Systems

Whether it's a supermarket, a furniture maker or a chip producer, every company is constantly looking for the most cost-efficient logistics strategy. It is not only the cost of material and labor that determine an item's production costs but also the storage and transport of parts, for instance.

Managing the flow of goods around a product, from the start of the supply chain to delivery to the customer is central to the Logistics Management Systems (LMS) program.

"Logistics strategies have always been important, but they have become more complex in the past twenty-five years," says Nico Dellaert, PhD, director of LMS. "Capital-intensive industries in particular, like Philips and ASML, outsource most of the components for their products to other companies. There may be up to a hundred suppliers for one product, mainly located in Asia. Good management of the supply line requires a lot of logistical planning."

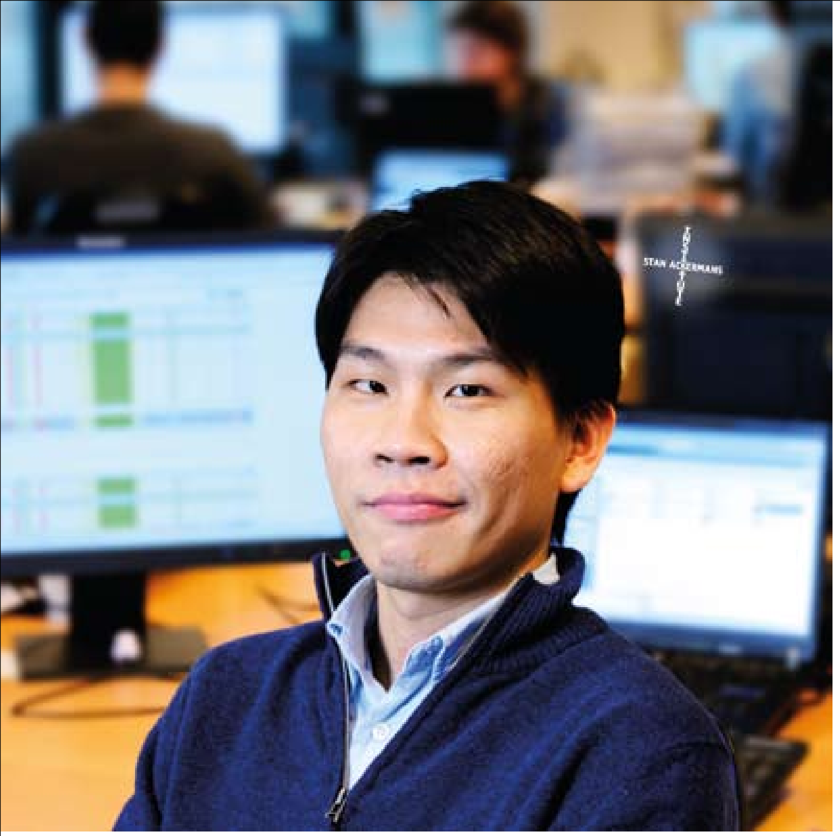
The demand for logistics experts has been considerable ever since the program began. LMS students carry out their end project at all kinds of companies like ASML, the National Railway, Philips Lighting, KLM and Heineken.

Since: 1988

Number of graduates until 2010: 298

The LMS program is part of the Eindhoven department of Industrial Engineering and Innovation Sciences

www.3tu.nl/sai/lms



‘The program has really changed me’

IMPROVED LOGISTICAL PLANNING OF SUPPLY CHAIN FOR ASML

‘Some LMS subjects were real eye-openers for me. I learned which factors you have to take account of in planning at a large company, something I just did not get in my Industrial Engineering study in Taiwan. The social skills I acquired were equally important. In Taiwan I was always very shy. Here I got some insight into my performance within a group and I learned to give presentations.
In the first year we did different design projects as a team. This was a very valuable experience for me involving, as it did, students from various cultural backgrounds. I noticed how each culture brought a different behavior with it. In Taiwan people consider it normal to work overtime whereas the Dutch generally have a nine-to-five mentality. Their

PO-CHUN (LIONEL) YANG
MSc, PDEng (2007-2009)

weekends tend to be free, and that is something I had to get used to. My main project at ASML centered on the supply chain of parts for lithographic systems. Companies often use a Material Requirement Planning (MRP) system, checking what parts they need and estimating when they should be ordered to get the product finished in time. And when market demand changes, the planning of the materials in the MRP system is adjusted.

Some years ago demand for ASML high-tech systems declined. MRP planning meant that a lot of materials stacked up from the supply line could not be used straightaway. They had to be stored, an expensive exercise. I investigated how the logistical planning could be made more cost-efficient and then made a supply chain control framework, a way of better controlling the supply chain.
In complex equipment around eighty percent of the production costs are contained in about twenty percent of the parts. If purchasing of that critical twenty percent can be better planned, the total cost can be reduced. So I recommended making an initial selection of these critical parts, giving them greater focus. By splitting the production of them into various stages, whereby ASML had more communication and coordination with the respective suppliers, the supply line can become more efficient, flexible, transparent and less uncertain.
Actually, planning the whole supply chain is a combination of ‘make to order’ and ‘make to stock’ planning. Some parts you would like to have in permanent stock so you can get started immediately when an order comes in (‘make to stock’). This is good for performance to the customer but it does require a lot of storage space. Other parts you make when a customer provides specific requirements (‘make to order’).
If the turnaround point in the planning of the supply line lies early in the manufacturing process at ‘make to order’, this can easily prompt a delay. This is even more likely the more uncertainties the production process has. On the other hand, you avoid purchases that are superfluous in retrospect. In the planning option, you have to take account of both cost-efficiency and performance.
I made a simulation model that calculates the consequences of a given choice for both aspects. The results of the simulation and the supply chain control framework function as a basis for subsequent projects geared to improving ASML’s planning system.

If I had opted to go to work in Taiwan after my studies, my professional life would have turned out quite differently. In Taiwan I often worked twelve hours a day for months on end, and sometimes even longer. This leaves little time for yourself. Here I have learned to enjoy life. Dealing with people from different cultures has been just as important as acquiring knowledge. It is an experience that has really changed me.’

ROGIER DE KOK
MSc, Logistics Supply Manager at ASML

‘Balance between delivery performance and stock costs is a logistical challenge’

‘ASML develops high-tech lithography machines for chip manufacturers. Developing a new generation of machines takes years and ‘time to market’ of new technology is essential. New generations of machine types succeed each other fast and the machines of a new generation undergo several engineering changes to meet customer requirements. ASML purchases more than ten thousand parts from over six hundred suppliers. We assemble these parts into modules and then into machines that are fine-tuned and tested before transport to the customer. The cycle time in the pipeline for ordering parts, assembling and testing machines is much longer than the customer order lead time, which makes it necessary to forecast future demand. That is not easy since the semiconductor industry is a very dynamic market. Furthermore, the ASML lithography machines are highly configurable, so customer specific. Flexibility is needed to respond fast to unforeseen changes in market demand. Therefore, we work structurally on reducing the cycle time in the factory and in the supply chain. In addition, we plan capacities and stocks in the chain to achieve the required flexibility. Finding the right balance between delivery performance and supply chain stock costs is a logistical challenge. As we think that improvements can be made in this area, we decided a couple of years ago to develop a new planning concept with TU/e and CQM.

One of the first questions concerned the optimum decoupling point between ‘make to stock’ and ‘make to order’. The higher upstream this lies, the lower the stock costs but the longer the delivery time. Lionel designed a simulation model to quantify the consequences of this choice. Following Lionel other TU/e people have worked further on the planning concept. Lionel created the infrastructure, in fact, and his successors have put various planning methods under the microscope since.

The insights developed by Lionel are still very practicable. Building a simulation model takes months of research time, so it is difficult for us to make people available to do this internally. However, this is not the only reason why we appoint trainees from the Stan Ackermans Institute. We also want to find out about the very latest insights being developed at TU/e. The trainees help us gain that expertise.

As a sequence to Lionel’s end project another SAI trainee has developed a prototype of a ‘scenario planning and optimization tool’ that provides insight into the balance between delivery performance and stock costs. The prototype helps us to draw up the right requirements for the definitive scenario planning tool.

The new planning concept embraces much more than shifting the customer order disconnection point and the scenario planning tool. I reckon that it will take about another year and a half before the new planning concept can be fully implemented. We then expect to offer our customers a higher delivery performance with lower stock costs and risks in the supply chain.’

Process and Equipment Design

Specialists from the Process and Equipment Design (PED) program have deep-seated knowledge and experience in designing chemical plants. This may range from bulk and fine chemicals to food chemistry and refineries.

PED experts are educated not only to design a good plant but have, moreover, a trained eye for the context of the plant: the economic risks, societal relevance, safety and environmental aspects.
"The PDEng candidates work on a safe and sustainable industry of the future," says Pieter Swinkels, MSc, program coordinator. "Not only are they conscious of their responsibility in this sense but they also have experience in applying design methods in which sustainability and safety are intrinsic elements. Separate from this, during their program they accumulate a wealth of engineering knowledge that they can use in industry immediately after graduating."

There is great diversity in the companies for which PDEng trainees undertake their design projects. Knowledge institutions such as TNO and the Energy Center for the Netherlands (ECN), large companies like Shell, DSM, Unilever and Akzo Nobel as well as smaller companies and design agencies are enthusiastic clients.

Since: 1991

Number of graduates until 2010: 134

The PED program is part of the Delft department of Applied Sciences

www.3tu.nl/sai/ped

FIETHAMELEKOT EMUN TEMELISO
MSc, PDEng (2008 - 2010)

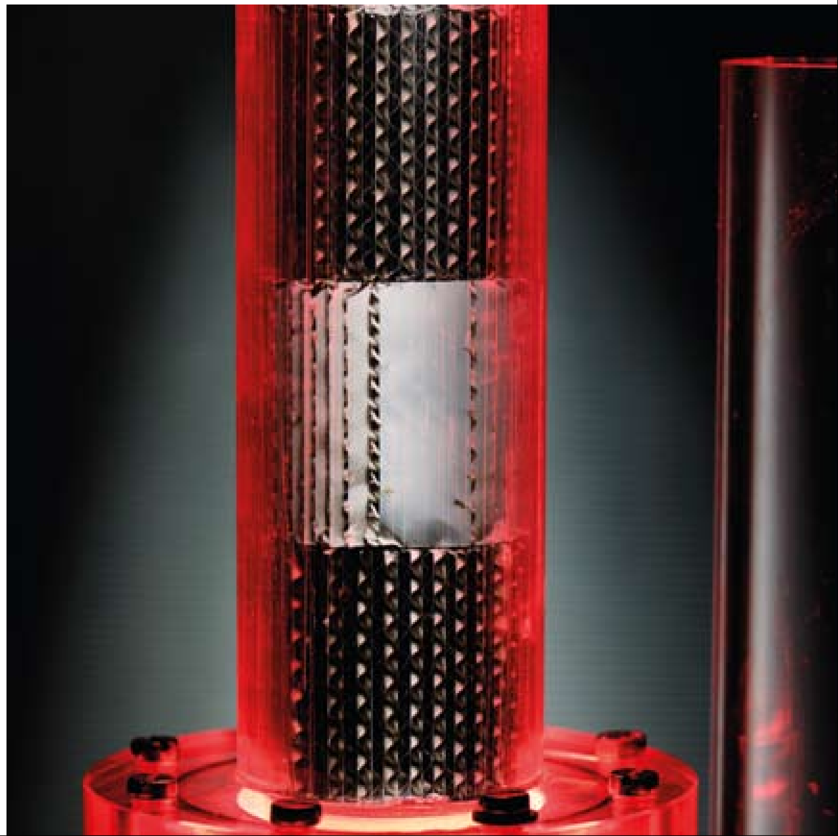
'I have never previously worked on such an innovative project'

OPTIMIZING INNOVATIVE FISCHER-TROPSCH REACTOR

'In Ethiopia I studied Chemical Engineering and in Spain I did my Master in Chemical and Process Engineering. After my studies I could have become a researcher but I was very fascinated about the world of industry and wanted to be part of it. This design project formed a nice bridge between the two worlds.

My design project was part of a large cooperation project involving Shell, TU Delft and STW. It concerned the development of Fischer-Tropsch technology: a method of converting natural gas into liquid fuel. This conversion required new, highly active catalytic converters but these generated a lot of heat. The controlled discharge of that heat was central to my project.
A conventional Fischer-Tropsch reactor contains thin tubes through which the reaction mix flows. Individual catalytic particles react with the gas and the resulting heat is absorbed by the cooling water that flows around the tubes. When the new catalytic converter is used, there is not enough heat discharge. So TU Delft is investigating a new kind of reactor in which the tubes contain thin, elongated strips ('structured packings') coated with the catalytic converter. While the gas flows between the strips, it reacts with the coating. The structure of the strips is such that the heat transfer can occur very specifically on the wall of the tube, making the heat transfer twice as efficient.
The concept for the new reactor already existed. My job was to mathematically model the entire system and optimize the design within a feasibility study. How thick must the coating on the strips be, how wide and long must the tubes be to achieve the optimum ratio between the costs and the efficiency of the system? Scientists tend to want to continue improving a design even if the economic gain in doing so is negligible.
A second objective of my project was to implement the Delft Template for Conceptual Process, developed by TU Delft. This highly structured method was developed to enable complex design processes to run as efficiently as possible. Shell wanted to know whether the template would be suitable for its design programs. I used the method and am very pleased with the result. My recommendation to Shell was positive.

I have never previously worked on such a major and innovative project. Nowhere else are 'structure packings' used in Fischer-Tropsch reactors. The cooperation with Shell was also very enjoyable and educational. Industry looks at the same things in a different way than universities do. Scheduling and management aspects are prioritized differently.
To witness that close up taught me a lot.'



Structured packings for new type Fischer-Tropsch reactor.


KOBE

Software Technology

The Software Technology (ST) program focuses on solutions to complex software problems in multidisciplinary environments. More and more software-intensive systems, like electron microscopes or wafersteppers (chip machines) are controlled by 'invisible' embedded software with the very highest levels of performance.

The software ensures the simultaneous operation of numerous processes realtime, often with microsecond accuracy and with a limited memory. This needs to happen robustly and year in, year out. Designing such systems demands more than insight into software.

"Team leaders in the field of software technology must have excellent social skills and considerable capacity for abstraction," says Dr. Ad Aerts, director of ST. "They negotiate with respective counterparts from every field about a package of requirements. They identify the software problem, break it down into sub-areas and put them in the charge of individual software engineers. They monitor the cohesion of the projects and ensure that the sub-solutions are integrated into a satisfactory result. After graduating from our program, the designers are ready to take on the role of leader."

The ST program works with various industrial partners, including Philips, ASML, Océ and FEI as well as the Embedded Systems Institute.

Since: 1990

Number of graduates until 2010: 327

The Software Technology program is part of the Eindhoven department of Mathematics and Computer Science

www.3tu.nl/sai/st

FRED VAN NIJNATTEN
MSc, PDEng (2008 - 2010)

'The program was a nice calling card'

DISEASED ARTERIES IDENTIFIED INTERACTIVELY

'Following my Computer Science and Engineering studies at TU/e, I wanted to gain experience in industry. A strong aspect of the ST designer program is that you undertake short projects in the first fifteen months for different companies each time. This means you gain experience more quickly than if you work at just one company. That really appealed to me. Initially you work on assignments in a group, with reflection of the development process a recurring topic. How is the project going, how much time is left, are we working efficiently? I also had to reflect on my role in the group process. What are my qualities and what is my input? When I chose this study, I wasn't aware of it at the time but in retrospect I think that it contributed a lot to my personal development. Because I was compelled to work with a lot of people, I became more assertive.

I graduated in the field of algorithms and was especially keen on visualization already during my studies. The subject for my graduation design project for Philips Healthcare in Best fitted that nicely. I had to design a system to visualize blood circulation in the human body. Doctors need information about blood circulation in the arteries to diagnose cardiovascular diseases. They often know that the arteries are constricted or stretched but they don't know how serious this defect is. This information is vital in deciding whether a surgical operation is needed. Quantitative Flow MRI (QFlow MRI) is a method to visualize blood circulation. The color intensity of the picture corresponds with the speed of the blood flow. For instance, you see white pixels for 'fast' and gray for 'slower'. Black pixels visualize blood flowing rapidly in the opposite direction. Hospitals use two-dimensional QFlow MRI for a 2D cross-section of the arteries. The downside is that the images are not easy to interpret. It also takes a long time to find the right place for the cross-section. If it is not the right one, then the procedure has to be restarted, which costs a lot of time and money.
My assignment was initially to develop an alternative method of visualization that is intuitive in use. The system I developed uses a three-dimensional QFlow MRI scan of an entire 'block' in the body. After the procedure the doctor can select the right cross-section by simply clicking on the respective artery. The speeds measured around the artery enable the amount of blood flow to be calculated. The old method did the same but my visualization method works much more intuitively and easily. On top of that, you just need one scan for several cross-sections.

However, I wanted my system to provide more than just information about the quantity of blood circulating through the arteries; it also had to reveal all kinds of qualitative properties of that blood flow, such as interesting flow patterns. In cardiovascular diseases, the focus lies on constricting and stretching of the arteries, and for certain defects an operation is needed. The future might see an operation take place on the basis of what is actually occurring in the arteries. So an accurate visualization of this is an initial and essential step.
My system makes visualizations of the blood volume in the arteries over time. In other words, it is a four-dimensional method of visualization. I made use of a collection of common visualization methods for the circulation data. The system assists scientists in their research into defects and diagnoses. It can also help to determine the relevance of the data. The project was very pleasing because I really had to delve into diseases and medical techniques. My focus on things other than computer science gave the project much more depth. If I had started work straight after graduating, I would never have imagined I would end up in this field. The program I studied was a nice calling card. I was surprised how many people I came across during my application had studied at the Stan Ackermans Institute. Many students may not realize it but the program is well known in industry.'

MARCEL BREEUWER
Professor at TU Eindhoven (department of Biomedical Engineering – Biomedical Imaging Analysis) and Principal Scientist at Philips Healthcare Best (MR Clinical Science department)

'Project is first step to a therapy simulator'

'The problem of stretched and constricted arteries is that the blood no longer circulates normally. For instance, swirling may occur causing the blood cells to collect in one spot and clot. To identify the nature and seriousness of an arterial defect, defective circulation has to be visualized. In recent years it has become possible using magnetic resonance imaging (MRI) to measure the blood flow in 3D.
Fred's program was initially intended to support the diagnosis of arterial defects. The next step, however, is to support the choice and execution of treatment. TU/e researchers at the department of Biomedical Engineering have been studying the computer simulation of various treatment strategies for some years. This 'therapy simulator' can be compared to the well-known 'flight simulator' that simulates different situations in an aircraft. Imagine that you could simulate the effects of therapy using a computer model. The doctor could try out different interventions and then select the most appropriate for the actual patient. The program developed by Fred can perform the measurements required for such a simulation.
Within Philips we focus mainly on developing products that will become available in the coming years. For longer-term projects, where the final product roll-out is an unknown, we like to work with ST trainees. These people are well educated and have experience in developing software. Of course, most have no experience with image analysis but we do. Since they understand what software development entails, they learn fast. In the nine months the trainees work for us, they are remarkably effective for us.

The ST designers are real builders, designers able to merge the various components into a new system. The components are not ready-made items; compare it with a toolbox, full of hammers, saws, nuts and bolts, whereby the designers have to think themselves what they are going to make and how. What is more, they do it all themselves: from drawing up a package of requirements and designing the architecture to building and testing the software system and writing the final report.
Typical of the trainees is that they learn to manage their own projects really well. You see that they can plan well and make a risk inventory. If something does not work, they know what to do.
When we are approached by the program, I first check out the CV's of the students and invite a few to 'apply'. The interviews with three of four of my most experienced colleagues are no walk in the park. We let them have their say to see how they present and how they respond to our questions. This is important given that they have to communicate well in projects. If a trainee cannot do that, then it costs a lot of supervision time. We try to find the combination of analytical thinking, good planning and communication skills, autonomy and experience in software development.
At the end of the application round, everyone has to be unanimous in the choice. With Fred we quickly got the impression that he fulfilled our requirements. Our expectations were more than met. I have never seen an ST trainee generate so much in those nine months. He is the quickest trainee I have ever come across, a real topper. We made sure we kept hold of him at Philips after he graduated.'

The future has much in store for the 3TU.School for Technological Design, Stan Ackermans Institute. The incubator of innovation experts is counting on broader support from the departments, greater visibility of the program, more entrepreneurship and even the prospect of a European title. Director Professor Kees van Hee and coordinator Ben Donders, LLM, MA, enlighten the plans.

On the road to more innovation

Universities have three tasks: development of knowledge through research, transfer of knowledge via education and validating knowledge through innovation. This third task, knowledge valorization, has been on Dutch university agendas for a number of years. The government also encourages through subsidies the transfer of academic knowledge to society in the shape of tangible applications. This is essential since the Dutch knowledge economy stands or falls by the health of its innovation climate.
Yet knowledge valorization at most universities still has an inferior position compared to education and research. “We create an incredible amount of knowledge,” says Kees van Hee, director of the institute. “There are some 19,000 scientific journals for bèta sciences. However, while all our ideas are nicely pigeon-holed along with the rest, a chasm still exists between knowledge and valorization.”

PUBLISH OR PERISH

Van Hee is keen to point out this blot on the academic landscape. The institute he represents has been a successful incubator for technological innovations and ambitious innovators for many years. The cross-fertilization between universities and industry so craved by the government has brought SAI plenty of success in the field over the years. Yet there is still considerable scope for improvement. Van Hee believes that the failure of knowledge valorization in the Netherlands to make more of a mark can be attributed to an academic culture that the SAI is also wrestling with.

"Since the nineties the scientific world has allowed itself to be governed by the 'publish or perish' maxim," he explains. "Now that scientists are being unilaterally benchmarked by their citation index score, there are ten times as many publications as in 1990. This has seen design shuffled off into a side street. We seem to have the least time for designing complex software or a carbon dioxide capture method: artefacts that can benefit society the most."
The director's appeal is certainly no cry in the wilderness. Following the broadly sensed need for a more flexible quality assessment of the designing and constructing sciences, the Royal Netherlands Academy of Arts and Sciences (KNAW) published the report 'Quality assessment in the design and engineering disciplines' in 2010. Its recommendation was that not only publications in the normal journals but also technological designs should form the key output by which the quality and societal relevance of research must be measured.

CULTURAL CHANGE

The three TU's took the lead in this KNAW evaluation. Ben Donders, coordinator of the SAI, is overjoyed at this new development and is optimistic about the future.
"If demonstrable design qualities are to be a serious component of the assessment of people, then a cultural change may occur within the university," he comments. "And that is vital in terms of the future of the SAI."
That cultural change is necessary to create broad and sustainable support for the designer programs in the departments. Many programs currently operate in isolation within their respective departments. The designer programs only fulfill their potential when a large number of researchers is actively involved in the design assignments and education.
"The programs are an ideal vehicle for mutual cross-fertilization," Van Hee explains. "Innovative design assignments within an industrial setting can form a source of inspiration for the research groups. Vice versa, industry profits more than ever before from our academic knowledge and, moreover, provide the perfect laboratory for us to verify our design methods against practice. The programs are good but we are striving to gain more synergy with the research groups around us."
At the moment supervisors of PDEng candidates tend to have a coaching role. In the future, however, the aim is to make more use of their expertise for the design project. It would certainly prove more appealing if the supervisor gained the requisite credits for this, just as in the supervision of a PhD student. Van Hee would also like to see even more staff members involved in the project.
"The design project would then gain a more obvious added value for industry," Donders says. "For companies not familiar with the SAI, this added value is not always apparent. So they tend to be wary about paying five thousand euros a month for a trainee. If the company benefits from a support platform of top experts, it is more willing to pay."

GRADUATE SCHOOL

In the context of a more design-geared university culture, the director expects much of the Graduate School that TU/e will be establishing. The university wants to integrate the Master program with the subsequent programs: the PhD and PDEng programs. Once students have completed their Bachelor degrees, they will be able to opt for two Master variants.
The one variant will emphasize research and the most logical next step will be a scientific PhD. The second variant will have a stronger design focus. If the student then wants to continue to study, he will opt for a PDEng program.
By bringing forward the moment of choice to the beginning of the Master program, the design-geared program will become a more evident option. However, the SAI programs will become more familiar to Dutch students that are often unaware of the programs. Donders also expects this option to attract more Bachelor graduates from other Dutch universities. "Our Master programs will acquire an added value that can make us distinctive from the general universities."

EUROPEAN TITLE

A significant portion of the PDEng candidates comes from abroad. The SAI wants to reinforce this international orientation by striving for a greater degree of cooperation with foreign universities. To this end there is consultation with English universities that offer similar programs. The SAI would like to see such cooperation result in a common degree.
The consultation has also been joined by a number of Swedish universities.
The institute's ambitions go beyond England and Sweden, however. Van Hee would prefer to see the designer programs hitch along with the European Institute of Innovation and Technology (EIT) established to encourage innovation processes in Europe. The aim is for Knowledge and Innovation Communities (KICs) to give Europe's innovation strength an added tangible boost. These KICs are partnerships in which people from higher education, research institutions and industry from all over Europe join forces to bridge the gap between knowledge and innovation.

To date the EIT has established three KICs in the fields of climate change, renewable energy and ICT. TU/e is participating in the energy and ICT KICs while Delft is taking part in the climate KIC.
“Designer programs in KIC fields are perfectly suited to shape innovation within the KICs,” Donders enthuses. “Students from all the universities participating in the KICs could participate in such programs. The programs may well be able to gain an EIT label, thereby making the PDEng degree a generally acknowledged, European title. We want to position the designer program as the European post-master in the field of innovation.”

QUALITY IMPULSE

Closer to home, too, the SAI has plenty of plans. In recent years much attention has focused on the quality of the designer programs, and an evaluation in 2008 revealed too many differences among the programs. Some focused too little on design while others did not emphasize systematic methodology enough.
Now there are verifiable criteria and a uniform quality standard for all the programs. However, there is still a need for more joint courses that will encourage the PDEng candidates to look beyond the horizons of their own discipline.
“In the first year of the program students work in teams on industry-derived projects,” Van Hee explains. “The teams currently comprise exclusively trainees from the same program. It would be great if the teams were made up of people from different programs since trainees always work in a multidisciplinary situation in industry.”

Van Hee considers equally important joint courses for generic design methods. After all, a certain systematic methodology applies to any sector the trainee ends up and to every design assignment the student has to undertake: whether it concerns a new railway timetable or a cardiac arrhythmia monitor.
Finally, the SAI wants to offer more customization in its programs, for instance for PDEng candidates that already have several years’ experience in industry. The programs are, after all, highly suited to companies that want to take advantage of Life Long Learning. Such an intake of students would mean that they would bring their own design problems with them. This does occasionally happen already (see chapter 9 on the Information and Communication Technology program).

ENTREPRENEURSHIP

Knowledge valorization and innovation are not separate from entrepreneurship. Elaborating an original idea into a usable artifact is only really worthwhile if it has a chance of commercial success. This is why the SAI wants its programs to focus more on how to use ideas in practice.
“You can conjure up a great idea but it has to be right on the button,” Van Hee says. “Does the invention fit in a specific context, will an innovation be easily accepted by an environment? Wat will it cost and what are the risks?”
With this in mind, the Brabant Centre of Entrepreneurship recently started giving courses in entrepreneurship to PDEng candidates. The aim is to enable them to gain a feel for business and so more easily be able to set up their own companies for a promising design. Further into the future Van Hee would even like to see the good ideas that are generated by scientific research find their way similarly into society.
“Now ideas are often confined to the shelf because it does not pay off in the current academic culture to get to grips with them,” he says. “It would be great if a PDEng trainee could take an idea for a new kind of product, service or system and develop this under supervision. For people, enthused by the urge to design and craving for business, to turn new knowledge into a start-up company – that is my dream.”
The director pauses before taking on a serious complexion. “For years there has been the call for more knowledge valorization and innovation. The designer programs could play a fantastic role in this respect. The design assignments are relevant for industry and innovative for us. That leads to real innovation in practice.”

Credits

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STAN ACKERMANS INSTITUTE

3TU.School for Technological Design,
Stan Ackermans Institute offers two-year
postgraduate technological designer programs.

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Delft University of Technology,
Eindhoven University of Technology and
University of Twente.

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