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.’