

Wim van der Hoek Award – 7: Niels van Giessen

Relying on the design principles

In 2016, Niels van Giessen won the Wim van der Hoek Award. As the eleventh winner, he was the first to come from a university of applied sciences – specifically, Avans in Den Bosch (NL). The jury advised him to place his trust primarily in design principles. He proceeded to do just that during his Master's in Mechanical Engineering at TU Eindhoven, and continues to do so now at Settels Savenije. "I prefer starting with a blank sheet of paper. In doing so, I can still learn a great deal from experienced design engineers and architects."



Niels van Giessen, a design engineer at Settels Savenije in Eindhoven, displaying the trophy associated with the Wim van der Hoek Award. He won the award in 2016 for his design of a robotic arm wrist joint.

Niels van Giessen (Den Bosch, 1990) was always tinkering and building things during his youth. Sometimes this was to help his father, a market

gardener, in the greenhouse. For his high-school graduation project, he built a trebuchet – originally a medieval siege weapon featuring a swinging arm. His version was a sling-based catapult capable of hurling bricks a distance of 100 meters. He wanted to conceive and create things, so a degree programme that allowed him to channel his creativity was the logical choice. He opted for Mechanical Engineering at Avans University of Applied Sciences in Den Bosch. While he enjoyed the subject matter, he was less keen on the class dynamic, so he switched to Communication & Multimedia Design. He completed that degree, but during the financial crisis, he did not see any career prospects that appealed to him. A chance encounter with a lecturer inspired him to pick up Mechanical Engineering again.

‘Like a magic box opening up’

The first course he took upon returning, Mechanics, immediately involved the kind of puzzle-solving he loved. “I’d missed this for four years,” Van Giessen realised. He became enthusiastic and landed an internship at Settels Savenije in Eindhoven (NL). There, Piet van Rens – a former student and colleague of Wim van der Hoek, and himself one of the ‘godfathers’ of design principles – had an interesting assignment for him. “Little did I know who he was! At Settels, people spent their days coming up with brilliant inventions; that was when I truly saw the light. It was like a magic box opening up; I learned a great deal from Piet and his colleagues.”

‘Effective application of design principles’

For his graduation project, Van Giessen ended up at VDL ETG, where they were looking for someone with a passion for design principles. The task involved redesigning the wrist joint of a robotic arm. The assignment focused on analysis to demonstrate that the existing design was inadequate. In the final week, Van Giessen took the initiative to show how the problem could actually be solved. He developed his own design and had a plastic model printed; it proved to be stiffer than the original metal mechanism. Moreover, the number of components was significantly reduced, and the design became much simpler. To his own surprise, this graduation project earned him the Wim van der Hoek Award. The jury was impressed. “Niels’s report is clear, and he possesses strong analytical skills. He

formulated concrete proposals for improvement, and his new concept serves as a solid starting point, demonstrating an effective application of design principles.”

‘He was 92 and still passionate about his profession’

The award was a recognition of Van Giessen’s graduation project. “But above all, it was about what Wim van der Hoek had achieved. I learned the craft of design and construction from people who had learned it from him. During the award ceremony, people gathered around him, full of appreciation for what he had taught them and for the culture surrounding design principles in the Netherlands – the way of looking at mechanical structures that he had introduced. That experience was what I found most special about the ceremony. It was also fantastic when Wim came over to me and took the trophy (which featured the well-known design of a parallel slit mechanism, ed.). He pointed something out and said, ‘That part needs to be thicker; otherwise, the mechanism will deform when you turn the adjustment screw.’ He demonstrated that it’s the details that make the difference. He was 92 at the time and still deeply passionate about his field. I found that inspiring.”

‘Building it to verify the design’

Encouraged by those around him, Van Giessen decided to delve deeper into the field of structural design at Eindhoven University of Technology (TU/e), where Van der Hoek had once served as a distinguished professor. “I took mostly theoretical courses there, many in the mechatronics domain. However, the applied course on design principles was the best. That remains the foundation, after all. More than subjects like dynamics and control theory, it focused on the reality behind the structure. Models and tangible structures, mathematics and hands-on tinkering – it all goes well together, especially when keeping in mind the knowledge from related fields. Even if you think you have a sound design based on fundamental principles, you really have to build it to check for any flaws in your reasoning. For a hobby project at home, I once made a motor mount using a folded leafspring. When I built it, the leaf spring deformed completely. Ah, right – I hadn’t constrained it properly in my design.”

‘Starting with a blank sheet of paper’

During the internal internship for his TU/e degree programme, Van Giessen worked on positioning fibres relative to an optical chip. “It had to be done as cheaply and quickly as possible. I simply started by looking at the degrees of freedom: which ones required active control, and which could be constrained passively? The question was which techniques would work best for aligning a fibre array with a chip. Could the light from the fibres be used for that purpose, for instance? That was the part I enjoyed most: starting with a blank sheet of paper to devise a completely new concept. The assignments in the programme were so broad that you could take them in any direction. Some people find that daunting, but I actually like it. I had to step outside my own field; for example, I read up on optics to understand the sensitivities involved and see what insights I could apply to the mechatronic solution I was developing.”



At Settels Savenije, Niels van Giessen works on high-tech projects: “Here, I still learn a lot from experienced design engineers and see what system architects do at a conceptual level.”

‘How can you not see that this is brilliant?’

Van Giessen immersed himself in the standard course notes and textbooks: *Des Duivels Prentenboek* by Van der Hoek, the lecture notes by TU/e lecturer Nick Rosielle, and *Constructieprincipes* by Rien Koster, Van der Hoek’s successor as professor. He also studied the inaugural and farewell lectures delivered by Professor Van der Hoek. “I kept studying the writings. At first, you do wonder exactly what you’re reading, but as you read more and use the material to solve problems, it all starts to make sense. That’s when you see the deep layers within the texts and realise they were truly written by a design engineer. I served on the programme committee for the Mechanical Engineering degree course; it turned out that many students found the course notes difficult. Yet, to me, it couldn’t have been written more clearly: ‘How can you not see that this is brilliant?’”

‘It was a dream job of sorts’

Van Giessen carried out his graduation project under the supervision of Raimondo Cau. Incidentally, Van Giessen only discovered after graduating that Cau was a previous winner of the Wim van der Hoek Award. The project involved a microsurgery robot for Microsure, a TU/e spin-off. The assignment was to investigate how the next generation of the robot could achieve a greater range of motion for even more precise applications. “There, too, I started with a blank sheet of paper. I observed surgeries to get a feel for how a surgeon works and what they do – or don’t – want to think about while operating. Surgeons and assistants need to be able to get close to the patient, and thus the robot, while the human-robot interaction must be inherently safe. A comprehensive set of requirements gradually took shape. It was a balancing act to arrive at the right mix of characteristics. For instance, I devised a new concept for the kinematics, among other things. This provided a great deal of freedom of movement without compromising accuracy. It was something of a dream job: you’re in a position where you have to use your creativity to do things that have never been done before.”

‘Seeking out experienced design engineers’

After graduating, Van Giessen could have stayed on at Microsure. There, he would soon have become a sort of lead design engineer within a small team. “However, I realised I still had a lot to learn from others and wanted to seek out experienced design engineers.” That is why, in 2019, he joined Settels Savenije – a company he already knew from his first internship – as a design engineer. “I’ve found that to be the right choice. I’m learning a great deal from the way my colleagues approach projects and interact with clients, and how they work together as a larger team towards the final goal of realising what are, after all, complex systems.” He is currently working on projects such as frames for measuring optical modules. This involves the precise positioning and alignment of components and the design of stiff structures with sufficiently high natural frequencies. “It really comes down to cleverly arranging sheet-metal parts, beams and struts within your design.” Familiar territory for a VanderHoek alumnus.

‘Continuing to develop my creativity’

Van Giessen has found his niche at Settels Savenije. “I’m moving into projects with greater technical depth, continuing to learn from experienced design engineers, and seeing what system architects do at a conceptual level. It’s inspiring to work with them.” He engages in conceptual thinking outside of work as well. “I’m working with my father on a kind of social project where we are trying to develop small, smart homes for singles and couples on a plot of land. It really comes down to the structural design – figuring out how to keep it super simple. Designs – especially in high-tech – are often overly complicated. That’s when you have to take a step back and strip away half of your design. As Piet van Rens once said, ‘Applying design principles is primarily a matter of thinking things through carefully.’ That’s the kind of work I want to keep doing in the high-tech sector – continuing to develop my creativity.” Doing exactly what the Wim van der Hoek Award jury advised him to do: “Relying on the design principles.”