Special aanstormend talent

Door J.C. Scholtens BSc

Building Aquabots

Towards Smarter, Safer and Future-ready Waterways

Jan Scholtens: 'Cooperating and communicating might be the most important thing every student in the Aquabot project learns' (picture: VOOG).

Jan Scholtens fulfilled different roles in the Aquabots project. First as a student, but after graduating he decided to keep working on small unmanned vessels and related innovations as an independent engineer. His company, Innoship Engineering, works together with other small companies as well as students to create a future in which more data is gathered on the waterways.

When I arrived at the RDM for the first time in 2014, I was there to work on a project as part of my Maritime Engineering studies. Out of the possible subjects of that semester, I chose the one where we had to deliver an actual vessel, not just a pile of paper. For this project, we worked in two teams, each building a 1.5-metre unmanned vessel that would have no emissions. With these vessels, we would have to sail a 3.5-kilometre track over the river Nieuwe Maas, between the STC building and the RDM in Rotterdam, the Netherlands. The goal of this challenge? Proving that it was possible to safely operate very small purpose-built vessels in the hostile environment that a waterway is.

After five months of research, design, construction, tests and discussions with the students of my own discipline and other technical studies, we crossed the Nieuwe Maas with the small unmanned vessels EindMaas and Aftica. These vessels were quite flawed and the crossing was not without error. Still, the achievement of the project was that, after this, the project was no longer a contest between two teams of students. Instead, it became a research programme working on drones that could operate on the Dutch waterways. This new research project was called Aquabots.

Gathering Knowledge and Passing It on

Following the Maas crossing, I went back to school and left the RDM for a few months. A new group of students received the two vessels built for the Maas crossing, along with a new set of goals they had to work towards. I was asked to come back during this period, to give a bit of advice to the students about the knowledge I had gained designing, building and operating the EindMaas. I was then asked to help with the outfitting of another vessel for a depth measuring demonstration for Rijkswaterstaat on the IJssel river. After that demonstration, a colleague and I were asked to manage and advise the next groups of students working on the Aquabots programme as a part-time job while studying. We took the opportunity and I have been working at the RDM ever since.

During this part-time job, I did not just pass on my experience to these students, but I also learned a lot myself. The students involved were not maritime engineers, but mechatronics, ICT and electrical engineering students. You would think that communication between the technicians of those fields would be easy, but when speaking about our disciplines, we all had our different ways of describing problems and components. I experienced for the first time how for example the ship design had an impact on the software of the autopilot, how the vessel's movement in waves impacted the sensors, and how the placement of power and motor control cables in the hull could affect other systems. I taught them about the effects their components would have on the Aquabot's movement and layout. Yet, both we and the other students especially learned that working together with people from different backgrounds and disciplines to create something that actually had to work, was something we all had to work on. This manner of cooperating and communicating may be the most important thing every student in the project learns, as it is not something your studies prepare you for in any of the classrooms.

Jan Scholtens is de oprichter van Innoship Engineering en werkt daar aan het realiseren van kleine onbemande schepen. Ook is hij instructeur bij het RDM Aqualab.

During this period, the students produced an Aquabot that would be the standard set for the next developments. The Aquabot could be controlled with GPS waypoints and was designed smart enough to be expanded upon.
After this, we moved on with our studies, starting on our graduation projects. The next group of students were counselled by two mechatronics students who had worked on the Aquabots project, again guaranteeing the gained knowledge and experience found its way to the next group of students. Still, I wanted to keep working on the development of aquatic drones, so I chose the next generation of Aquabots as my thesis subject.

The Aquabots EindMaas and Anna giving a show at the RDM Dokhaven (picture: Roy Borghouts Fotografie).

Modular Design and Construction

This next generation of Aquabots would have to be suited for actual professional use. I immediately ran into an issue: how to design a vessel for which the requirements were not yet based on a real situation? The students had proven that it was possible to safely operate Aquabots on the waterways with sensor systems on board. It was, however, unknown what the requirements for Aquabots were before they could operate on the waterways for actual inspections and monitoring. The requirements for the earlier vessels were all set by teachers and practical concerns, such as the ability to be transported by cars, the size of the test basin or a certain assumed cargo. To actually create an Aquabot that could be used professionally, I visited companies and organisations that would be interested in using it, and questioned them about what would make an Aquabot a usable tool for them or their subcontractors. From their answers, I began to setup the actual requirements.
These requirements were different from what I initially suspected. The requirements in sensor load, vessel size, operating conditions and amount of autonomy were variable, meaning that there was very little a design for these operators would have in common. When I started to see what the requirements would result in when put together, it was nearly impossible to design something that would be suitable for all. In addition, since Aquatic drones are not yet used on the waterways, it was unknown what other requirements would be when these vessels would be used operationally. The solution I found was to abandon a single design that would work for every user, and instead go for a design that was as variable as the requirements.
This resulted in a design that was modular: any set of Aquabot components would have to work together without any rebuilding, redesigning or reprogramming. I created a design that would pass the expected safety rules in all configurations, along with a calculation tool that tested the possible configurations of hull sizes, hull shapes and component choices. With that design, it was possible to create Aquabots for almost any task I could think of, without spending weeks modifying and optimising the design for that task. The design I had created could now be built for numerous different tasks and customers, without a large cost increase.
While working on the design, I was asked to join the team of Genuin.Engineering at the RDM for a short while. This startup company was asked to develop a prototype of the Wasteshark for Ranmarine. Yet, they lacked the expertise to build and design boats. The Wasteshark is a small unmanned vessel designed to gather floating trash from the water in port areas. With the team, we built the first two prototypes – from idea to in the water – in just a few weeks, so these could do demonstrations during the World Port Days in September 2017 in Rotterdam. This was my first time working together in a team of professionals instead of students, leading to a design that was completely different from everything I had done before. The experience from this project found its way into my graduation report and in all the work that I have done afterwards.

Cooperation Is Key

An important part of the Aquabots project will always be cooperation. The project itself is set up as a cooperation between RH Marine and RDM Centre of Expertise (CoE), with RH marine supplying budget and research subjects and RDM CoE managing the project and bringing in the students of the Rotterdam University of Applied Sciences. Sometimes students from other institutes are part of the project, such as Techniekcollege Rotterdam, TU Delft or the Haagse Hogeschool. In addition, the Knowledge Centre Sustainable Port-City allows students such as myself to do research and graduation projects that are part of the Aquabots project.
During my time working on the Aquabots project, it has grown larger still. I have found myself cooperating with companies and people both inside and outside the RDM area. The Aquabots project and RDM CoE have become a central hub. Here organisations such as IHC MTI, RH Marine, Rijkswaterstaat, MH Marine, PK Marine, Condast, Aqitec and many others find ways to cooperate with each other and students to create new developments and projects.
This cooperation between parties of all levels, sizes and expertise is the cornerstone of what I have learned at the RDM, and I hope to keep developing new ideas, learning new things and pass it on to the people I cooperate with. After graduating, I took on two new roles: I started working as an instructor at the maritime education and testing facilty Aqualab of the University of Rotterdam and I started up Innoship Engineering, becoming one of the partners in the Aquabots project. As such, I keep cooperating both with the students and with other small companies to keep developing interesting systems to make the waterways smarter, safer and ready for the future.