During his distinguished career as professor of Coastal Engineering at Delft University of Technology (TU Delft), Kees d’Angremond served as head of Hydraulic and Offshore Engineering, chair of the department of Hydraulic and Geotechnical Engineering, and dean of the faculty of Civil Engineering from 1989 to 2001. Now professor emeritus, he still works as an advisor and independent consultant. We invited Kees to a conversation with Stefan Aarninkhof, professor of Coastal Engineering and chair of the department of Hydraulic Engineering at TU Delft, to talk about their careers in the dredging industry and the role of academia in the industry today.

SHAPING THE ENGINEERS OF TOMORROW

The path into academia
Kees graduated as a civil engineer from Delft University of Technology in 1963. He worked in the lab of Delft Hydraulics (now Deltares) for two years before being assigned to a project in India, even though as he admits he was far too junior to do the job. Upon his return he became head of Delft Hydraulics’ wind-wave flume, where all the breakwaters are investigated.

Around 1970, Eco Bijker, who was the deputy head of the Delft Hydraulics’ laboratory, was appointed as the first professor in coastal engineering at Delft University of Technology (TU Delft). Eco was also lecturer at the IHE Delft Institute for Water Education (IHE Delft) at the international course in Hydraulic Engineering for engineers from developing countries. However, there were people from all over the world – from Australia, the USA, Canada, India, Latin America and Africa. Eco had no extra time and so he asked Kees to take over lectures at IHE Delft on breakwater design. There Kees met students from all over the world and expanded his network immensely.

In those early days, the way the Netherlands facilitated these students was insufficient. Adequate housing was not provided, and most students didn’t have extra money for what was already at that time expensive student rooms, or they were living in less than ideal conditions, for example, five students to one room. Since Kees knew the conditions were so poor, once a year he invited the whole class of 30 students to dinner at his home and his wife mobilised their children to help with all the cooking. These gatherings allowed him to experience the cultural differences between the many students, knowledge that would serve him well throughout his career. Many of his professional contacts in his working life were actually his students and also became friends for life.

Kees benefitted tremendously from these early student contacts. In later years, they would meet each other at various conferences such as PIANC. Within the COPEDEC (Conference on Coastal and Port Engineering in Developing Countries) society, there were numerous students who joined those yearly gatherings.
There was a sense of urgency and cooperation was key to making the Eastern Scheldt Storm Surge Barrier a success.

The Delta Project initiated the founding of Delta Hydraulics in 1957 and facilitated the design of the Afsluitdijk—a major dam and causeway in the Netherlands that closed off the Zuiderzee (a shallow bay of the North Sea) with all the tidal consequences. At that time, it was a major enabler for hydraulic research and formed strong network for cooperation. As was the Netherlands Centre for Coastal Research (NCK), which over the last 30 years has been a key network for scientific collaboration between different universities, Delta’s and the government. Stefan explains, “This is in fact where research on the interaction between hydraulics, morphology and ecology was born with a few pioneers in the field who started developing new research lines. It’s actually where the basis for building with the nature comes from. Together with course of the many initiatives taken by René Waterman, who promoted the implementation of Building with Nature solutions on real-world projects in the Netherlands as well many other locations worldwide.”

It’s true to say Kees found it a marvellous time in his career. “It was a period when all the barriers between contractors, government and consultants completely disappeared. There was a sense of urgency and cooperation was key to making the Eastern Scheldt Storm Surge Barrier a success.”

TASS programme was established as a strategic initiative to develop and implement novel approaches for marine infrastructure we need that same spirit and sense of urgency when it comes to climate adaptation.

In the end, there were six companies of which only those companies that could incorporate research capacity and which would really want to work not only as a project manager but also as secretary of the steering committees that consisted of all the board members of the large dredging companies. He facilitated the negotiations between the group of contractors and Delta Hydraulics and in this way, completely from the research side.

A couple of years after the India project, a second project in Burma came along and Delta Hydraulics asked him again. For a second time Kees agreed. Every two months he would leave his family in Rangon and travel from Burma back to Delft for a week to hold a meeting with the technical management of the dredging companies to keep the research project running. In that period, Age Hoekstra, the successor to Eco Bygger at Delta Hydraulics, had joined Adriaan Volker Dredging company and asked Kees to come work for Volker. At a certain moment, Age visited Kees in Rangon to persuade him and impressed by this enthusiasm, Kees signed a contract with Adriaan Volker and so Kees’ career in the dredging industry began.

Career similarities

Stefan’s introduction to the dredging industry was somewhat similar to Kees. In fact, there are many similarities in his work to their careers evident. Stefan had completed a PhD thesis at Delft University of Technology on the video imaging of coastlines. And had been at Delta Hydraulics for 8 years when he became involved in a large-scale research project for the industry-sponsored foundation for dredging-related strategic research, Stichting Bouwverkerk (Bagger)techniek (SBT).

Then in 2005, the dredging industry was looking for a project manager to lead a series of large-scale field experiments on dredging-induced turbidity as part of the SBT-TASS programme. People, such as Cees van Rhee, Wim Rosenbrand and Wouter Glinks were heavily involved in this research. At the time, the generation of dredging plumes was one of the major uncertainties on dredging projects, as an increase in turbidity levels is associated with the released light attenuation in the water column and possible smothering of sensitive ecosystems.

To avoid negative impacts, dredging projects often came with strong environmental restrictions; however, the scientific basis for these restrictions was not always very strong. First because dredging-induced turbidity plumes were hard to predict and second because limited understanding of the actual impact to sensitive ecosystems at the time. The SBT-TASS programme developed a series of large-scale field experiments around dredging activities in Bremenhaven (Germany), Rotterdam (The Netherlands) and in Western Australia. Moreover, a model was developed (together with HR Wallingford, UK) to enable improved assimilation of dredging-induced turbidity plumes into environmental models as well as the far-field plume dispersion.

The programme had major impact in the field not least because all outcomes were shared with the dredging research and consultant community via conferences, training courses and literature.

After a year in this role of project manager, Stefan made the move to Brussels to join their in-house engineering department Hydromac. One of the major projects he was involved in was the Rijkswaterstaat Port and Coastal Zone project (UAE), a scale-port development scheme in a sensitive environmental area. The programme was established as a strategic initiative to develop and implement novel approaches for marine infrastructure. We need that same spirit and sense of urgency when it comes to climate adaptation.
Knowledge of the industry

Starting in the industry, Kees had 12 years’ experience in hydraulic research and research management but no real practical hands-on experience in the dredging world. He knew the science behind the practice but nothing about the reality of dredging. Therefore, he started in the engineering department of Adriaan Volker’s company that still exists today as AVECO (Adriaan Volker Engineering Consultants).

The first project Kees worked on was a study on an issue he found very alarming – the pollution of dredged material in NGSO was claiming that dredgers were spoling the environment. Whereas the industry said, ‘We are not spoiling the environment, we just moving the material that is contaminated by others’. ‘The image of the dredging industry was not very positive in those early days. There was even a visual hindrance in that others’.

According to Stefan, the SSB research was also an enabler for scale increase. The big projects in Singapore and Hong Kong would settle in our estuaries is no longer polluted, otherwise you cannot be a proper engineer.”

The attention was not restricted to the disposal of material, it was also attempted to reduce the impact of material on the actual digging location like the cutter of a CSO, the bucket of a BS D and the dredge head of a TSHP. The development of the dredging industry together with supply chain partners and research institutes has resulted in several very effective measures such as the green valve system for trailling suction hopper which reduces turbidity caused by overflow during the dredging process. The knowledge collected by environmental monitoring was evident in decisions on dredging around coral reefs. And the development of predictive models and simulation tools contributed to knowledge-based decision.

A more formal approach to training

30 years ago, dredging was considered professional as an art rather than as a science. Later it came the realisation that a more formal approach to training than practical experience was desirable. When Kees was appointed professor at Delft University of Technology, the only education in the field of dredging was in the faculty of mechanical engineering and core of that course was the construction of dredging equipment. It was not aimed at working within the industry, so some of the professors tried to introduce the subject. There was hardly a civil engineering student who studied dredging.

According to Stefan, the SSB research was also an enabler for scale increase. The big projects in Singapore and Hong Kong would have never been possible without the work of SSB. It goes even further back. All the ports in the Middle East where rock dredging was taking place would also not have been possible without the fundamental research on rock cutting and cutter suction dredger in the beginning.

From that perspective, the dredging industry has come in, continues Stefan. ‘It’s generally means that there is nothing there. Only a beach and an ocean and there you go. That’s still the case, but at the same time, the industry wants to work in a responsible way. That’s still the case, but at the same time, the industry wants to work in a responsible way.

Teaching the commercial aspects of the industry

According to Kees, it is a responsibility of all universities to teach the commercial aspects of the dredging industry. He explains, ‘You’re not simply preparing students for their future work, you’re preparing engineers for a life in the real world. Whether it’s working in the government, as an accountant or as a consultant, the students have to realise it is part of their education. You have to realise that everything costs money otherwise you cannot be a proper engineer.”

In broadening the conversation, Stefan explains: ‘This is a one element where we want to educate students. At the end of the day you want to apply your technical knowledge and expertise in a real-world context. And the commercial consideration is one element of that context. You want to employ an engineer who knows how to apply their knowledge to the benefit of something bigger. The environment aspect is another element. As an engineer you also need to be able to communicate to an ecologist for instance and to be aware of the impact of dredging activities to the outside world. You don’t need to become an ecologist, but you need to be able to interface with people in this and other specialties.’

You have to teach students how to look at a project from so many different perspectives and the local culture is one of them.

Figure 1: Stefan Aarninkhof (left) and Kees de Angemond.
A good engineer has an international orientation. Engineers today have to have a broad skill set in that they have to deal with the global economy. This is one point Kees is very adamant about. Students are not only focussed on advancing science, but also being able to do the job in the correct manner with patients from different cultures, with different perspectives and the local culture is one of them. I think you can compare engineers to doctors in the same way they have to have a completely applied medical education, which is aimed at not only scientific skills and personal leadership to solve complex problems across the world. In line with this, universities and researchers are no longer evaluated solely on the basis of an indicator such as the number of publications, but on a broader range of qualities and impacts—whether fundamental science, or benefits for society.

The university aims to bring those people together and create an open atmosphere where people from industry, from the outside world can collaborate. As an educational institute, Delft University of Technology can say something is important but it’s much more convincing if the industry or the government says it is the right way forward and gives it an agenda or a perspective to which the university can contribute.

Is practical experience an essential element in academia? For Stefan, it’s a question of balance. Of course, it has its advantages as studying hands-on expertise, which comes from having knowledge and experience in the industry. But scientists are also needed. And what about a feeling for policy and good people managers, they are also indispensable. It’s all about having balance. That’s something that should be valued. Universities are made up of a group of extremely bright individuals, each with unique skills and talents. Academics by nature are quite competitive as they need to develop their research profile and win projects and research grants. “However, as far as teamwork goes, they can probably learn from the dredging industry, where teamwork is common practice and a prerequisite for successful projects.”

“Field trips give students an invaluable insight into what’s expected of them in the industry.”

The importance of field studies
One of the benefits of Stefan’s role is seeing students get inspired. For instance, during study tours to major projects abroad, the student association for Hydraulic Engineering (Waterbouwd forfeit) is very active in organising such trips and in 2019 traveled to Brazil. Back in 1994 as a student, Stefan was personally involved in the organisation of the tour to Taiwan, Hong Kong and China, together with Tim Meheut, Ronald Boersma and Janet Kroes. One of the highlights was the visit to the famous Chek Lap Kok airport that was under construction (Figure 4). Keess joined the tour as a supervisor, spanning nearly three weeks with the students, sharing his vast experience of working in the Far East. This trip, along with so many others, provide an incredible experience. They not only give students a unique opportunity to get an inside view of international marine infrastructure projects but also invaluable insight into what is expected of them in the industry. As a contractor, no matter how scientific you are or how many doctoral degrees you have, you have to get your hands dirty to gain credibility within an organisation,” explains Stefan. “It’s an important characteristic of the industry. As a young employee, as a mid-term career employee, you need to be open to that.” It’s one of the reasons why Stefan is keen to maintain the course on field experiments, under the supervision of Matthieu de Schipper. For example, students get to carry out field experiments in the near shore zone where the waves are breaking and you can see the sediments being transported. As Stefan explains: “The course is co-funded by the Dutch Association of Dredging Contractors (Vereniging van Waterbouwers) as they find it important to be able to hire students and young engineers, who are experienced with the forces of nature.”

No matter how many doctoral degrees you have, you have to get your hands dirty to gain credibility within an organisation.

Real-time monitoring data can also play a role in building up a good and open working relationship with the client. Such data are usually collected as part of large-scale construction projects. For instance, to verify if environmental limit values are being met. By sharing such data with the client (or even making it publicly available), the contractor gains confidence in the work methods applied and the management of its dredging operations. But you still expect that they also have the practical experience and know how to carry out the job at hand.

Field trips give students an invaluable insight into what’s expected of them in the industry.
ACADEMIA to get all your stakeholders on board from the clients and consultants that complex projects Dredging companies today have to convince Can academia play a role in sustainable Open communication proved to be a key sense. How companies communicate to the dredging industry has matured in that away from that initial mindset but I think a contractor would sit on the data to keep the Kees d’Angremond advising on the reclamation methods in Pulau Tekong, Singapore. TERRA ET AQUA (Association of Nature Monuments), as of a cooperation between the industry, Wadden project is an excellent example opposing development proposals. The Marker of working that way rather than simply beginning of a project and seeing the benefits Today, NGOs are getting involved at the There are many more examples – the Sand Motor is a prime example, where the World Engineers should be sought. There is great need for qualitative assessments, because the question is based far too much on ‘narratives’. As Stefan comments, ‘at the very least we should start making an assessment of what is known and what is happening in different scenarios, because the longevity of these large infrastructure interventions is not infinite – you design something to last for 50 or 100 years. Then you can use that as a basis of decision making’. One of the plans that is on the table is the DELTA21 idea, a future-proof solution for the southwestern Delta, providing a solution for flood protection, energy storage and nature restoration. ‘What’s inspirational about this idea is building something at the seaward side of our country to solve a problem inland. There’s a lot of inspiration in this way of thinking. It’s all about coming up with solutions and quantifying them, and not betting on the narratives or gut feelings. And that’s where engineering comes into play.’ A sentiment fully embraced by Kees: ‘It needs to not only be dreamed about but it also needs to be calculated!’ Greatest achievements After a moment of contemplation, Kees smiles and says, ‘I’m most proud of the number of students I’ve taught during my time as a professor and that they all found their career path.’ He was a professor for 12 years so approx. 50 students per year, that is approx. 600 graduates in total. ‘Most of them landed where they should and that’s an achievement.’ He is also proud of his role in the early dredging research programme that he helped start and later was chair in Singapore. After his retirement, he was invited by the Singapore Government to help them in a court case with Malaysia, concerning environmental problems. Together with colleagues, he supervised research studies by different labs and evaluated the results. Then they made a proposal to the two countries and their recommendation was adopted by the negotiating politicians to settle the court case out of court. For Stefan, his greatest achievement comes from his role in EcoShell and that he was able to make a difference, not only in the programme itself but also in the change of mindset that it evoked. As he explains, ‘An important thing is what the consequences of certain measures are. And it shouldn’t be limited to the Netherlands. The cooperation with other institutes, such as the US Army Corps of Engineers should be sought.’ The research initiated into this idea is a prime example. It’s just incredible to think of all these dredging companies together with academics and NGOs working together on improving coastal protection in the poorest regions. The business case is still under development but at the time of writing it’s a crucial project for local communities. These are the examples that appeal nowadays to students, engineers who want to help solving engineering knowledge into practice in this new environment. It therefore helps greatly if they have seen the hydraulic world from different sides.’ Plans for the future For Kees, his sights are set on the coming few years. As a consequence of his role in the court case in Singapore, he was asked by the Singapore government to assist them in designing some of their land reclamations works. After many years of discussion, designing and debating, it was decided to build a polol in Pulau Tekong, Singapore. A project that he still supervises and one that he is very proud of. Stefan has many plans for the future, including educating students, having students of hydraulic engineers and promoting the concept of Building with Nature as a means to develop climate resilient solutions. Because the base of such solutions can differ great opportunities to participate in with these solutions from living lab experiments, that translate into knowledge into designing guidance for future projects and Establishments an education centre to raise the engineers of the future.operations. A sharp contrast to the days when a contractor would sit on the data to keep the competitive edge for the next project. Stefan confirms: ‘Of course, it took time to move away from that initial mindset but I think the dredging industry has matured in that sense. How companies communicate to the public has seen a big turnaround: Open communication provides a way not only for the completion of the Hortipool Bay channel deepening project in Melbourne, sharing of data to inform both stakeholders and the public in letting turning it into a successful project.’ Can academia play a role in sustainable infrastructure? Dredging companies today have to convince clients and consultants that once complete projects should be done in a sustainable way. You need to get all your stakeholders on board from the very beginning, carry out ecosystems services assessment, establish what the impact your projects has on all this and invents all the externalities to see how sustainable a project really is. ‘This is where science and knowledge development is an excellent starting point,’ comments Stefan. ‘You have to start building those relationships because knowledge development it itself offers no commercial interest. However, it helps in building trust, not only amongst the companies you work with, but also research institutes, ecologists and NGOs.’ Today, NGOs are getting involved at the beginning of a project and seeing the benefits of working that way rather than simply opposing development proposals. The Marker Wadden project is an excellent example of a collaboration between the industry, Rykwesterst, Natuurmonumenten (Association of Nature Monuments), as well as universities involved nowadays.

What’s inspirational about the DELTA21 idea is building something at the seaward side of our country to solve a problem inland.

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Plans for the future

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