

# 4 generations in high tech

**The semiconductor industry is celebrating its 70th anniversary. What did that journey look like? How did we get from the first transistors - your (grand)parents can tell you all about it - to chips that use light and quantum mechanics to enable our everyday lives? We interviewed four generations of people working in the world of chip technology, as they shared their stories, dreams and hopes for the industry.**



**RICHARD BINNENDIJK: HELD VARIOUS POSITIONS AT PHILIPS IN NIJMEGEN FROM 1965 TO 2003.**

Our world runs on chips. Richard has witnessed this development from the very beginning. In 1965, he started at Philips in Nijmegen. Over the subsequent almost 40 years, he held various technical positions and watched the company grow tremendously. These days, Richard is occupied with the Novio Experience Museum (NEM): a foundation dedicated to preserving the high tech heritage of Philips and NXP. Richard takes us back to the early days of chips, transistors and high tech history.

**You joined Philips when computer chips and transistor technology were in their infancy. What was the work like back then?**

"In the past, there was a lot of physical work required. Back in the day transistors, the predecessor of a chip, were put together by hand, one by one. With time, this procedure became more automated. Assembly lines were

introduced first, and then machines gradually took on more responsibilities. Until the late 1960s, people did all design and calculations by hand. It wasn't until the 1990s that we started using computers!"

**From transistors to chips, that seems like a large step. How did you go through this transition?**

"The shift from transistors to chips may seem like it was a big deal, but the basics are still the same, just on a smaller scale. Parts have become smaller and need to be more precise. I believe the biggest change we made required creating our own precise machines because we couldn't find any available elsewhere. Additionally, I spent some time functioning as a manual component tester."

**In your opinion, what caused the success of the Netherlands - and especially Philips - in making computer chips?**

"During my time working for Philips, I moved around to several departments, building connections with many people. This allowed me to stay up-to-date on everything happening within the organization. We frequently worked together, with a relaxed and informal atmosphere. There was minimal hierarchy, and everyone could easily mingle and communicate. We always wanted to try new things and loved our job and the things we were working on. This mindset, along with a culture of trust, created a fertile environment for innovation and progress."

**What is your vision on the future of chip technology?**

"We've made a lot of progress, and I'm proud to have been a part of that. However, we have to be cautious not to rush things. What used to take a year now happens in a month. When something is possible, we quickly put it into action. As a result, we don't always take enough time to consider the implications of our technology. At times, it seems like we're taking a step forward without fully understanding where it will lead us. If we keep considering how we're going to introduce new technologies in the future, we can go very far."

1958



**JOOP BRUINES: MODULE LEAD SEMICONDUCTOR PACKAGING AT HAN & CHIP INTEGRATION TECHNOLOGY CENTER**

Joop started his career in the chip industry in Eindhoven, at Philips. He was involved in the building of the French chip factory Crolles1 and the Nijmegen chip factory ICN8. Now, he is responsible for educating a new generation of high-tech students in the Semiconductor Packaging course at HAN and CITC.

**How did you get involved in the semiconductor world?**

"In 1989, I stumbled from research into the world of chips at Philips, just in time to experience the Centurion crisis. That was a strange period: Operation Centurion was a big reorganisation for Philips. In Nijmegen, people were laid off because the plug was pulled on the European mega-project with Siemens. At the same time, we were moved from Eindhoven to Nijmegen. Later, Philips partnered with STMicroelectronics and France Telecom. And they build a development centre and factory near Grenoble: Crolles1."

"I was one of the first people sent by Philips to help start up the French factory. A few years later, I did the same with the ICN8 factory in Nijmegen. That factory was only half furnished. We were responsible for the other half. It

was surreal: the five-story building didn't even have floors yet. It was aptly nicknamed 'The Cathedral!'"

**What has been the biggest change in the industry for you?**

"The biggest change for me in the past decades was the emergence of integrated circuits (ICs). That development not only meant a lot for the industry, but for our whole society. What a breakthrough! Smartphones, laptops, you name it: none of it would have been possible without ICs. Before we were able to integrate, we were working with discrete elements. That means that everything was very bulky, because every element needed its own space, and energy hungry. Because of integrated circuits that no longer was the case, and we were able to develop a generation of smarter, leaner and faster chips."

**How did you end up at the Chip Integration Technology Center in Nijmegen?**

"In my last years with NXP, I did a lot of work promoting the technical field at primary and secondary schools. I noticed that imparting my passion and knowledge was something I enjoyed a lot. When CITC was still in formation, I asked them if they had an educational job for me. They told me they wanted to set up a course together with HAN, NXP, Nexperia and Ampleon, and asked if I was interested in leading that project. Of course I was!"

**How do you see the Dutch chip industry developing?**

"The biggest role the Netherlands can play in the chip world is in chip design. The ChipDesignNL consortium is now working hard to create a bigger role for us in that area of development. On the other hand, we can also make great strides in the field of optical chips. NXP produces electrical chips, but both types of ICs are complementary. SMART Photonics from Eindhoven produces such optical chips. They recently received a 100-million-euro investment from NXP, ASML and the Dutch government, among others."

"I'm glad and proud to see the chip industry is still flourishing. Of course, we have closed three factories in recent years. But ICN8, the factory I helped build, is bursting at the seams! NXP is very good at combining technologies. Think digital and analogue, but also digital and RF. These kinds of innovations, we do well in Nijmegen and the Netherlands. Cross-functional thinking and exploring boundaries. That's where our opportunities for the future lie!"

**"Because of integrated circuits that no longer was the case, and we were able to develop a generation of smarter, leaner and faster chips."**

1985



**JUDY TILLAK: PRINCIPAL PRODUCT QUALITY ENGINEER AT NEXPERIA**

Judy Tillak has extensive experience in the field of microelectronics. In the previous twenty years, she finished multiple studies and worked at various companies worldwide. Currently, Judy works at Nexperia, where she helps the company to bring products, specifically integrated circuits for social electronics, into the market by assuring the high quality and reliability of their production.

**What led you to the world of computer chips?**

“My father is an electronic engineer, so ever since I was little, I have been surrounded by electronics. Basically, it was a natural path for me to follow. I started immediately with integrated circuits and did my bachelors and masters in microelectronics.”

**How did you end up working at Nexperia?**

“Nexperia gives me an opportunity to grow into more mature roles in electronics and circuit design. That was my primary goal when I switched jobs. Before I came here, I used to work for a small startup company here in Enschede, which was amazing and challenging as well. However, at a bigger company like Nexperia, I was able to actually see the real big world of electronics.”

**What changes have you noticed, moving from a small start-up to a large company like Nexperia?**

“Many changes on many levels. In the way of working, but also in the way the teams are structured. The diversity in experience is much larger in a bigger company. At Nexperia, I work with people from different backgrounds but also with different experiences. That makes it a little bit more interesting in the sense that I’m learning much more.”

“In the way of working, what is to be done and expected is more put in place compared to smaller companies. Getting into these processes allowed me to learn much more about how product introduction is being done in a big corporate world.”

“My job has room for critical thinking and creativity but within the boundaries of what is expected from me. At a startup company, the sky is the limit. Basically, anyone can do anything they want, and that doesn’t necessarily mean that it’s working towards the product introduction. I did enjoy working there, and I’m really grateful for that opportunity to meet people, share ideas, and experience a lot of good energy and great dynamics. It’s not better or worse, just very different.”

**What do you think the future holds for the chip industry?**

“When it comes to the quality of the organisation, meaning knowledge and experience, I can see Nexperia growing organically and sustainably. And I see a future in this type of development.”

“I’m pretty confident that the semiconductor industry, and especially essential electronics, will continue to grow. We’re going to find new markets and new challenges where we need to find our path. Artificial Intelligence, for example. We don’t know what is going to happen, but we can all see something big is on the horizon.”

**“At a bigger company like Nexperia, I was able to actually see the real big world of electronics”**

**What is your personal vision for this future?**

“Sustainability and sustainable growth are very dear to me. It’s something I’m trying to make part of my life, and I’m trying to advocate as much as possible within my organisation as well by addressing the small changes that will make a significant impact in the future. The growth is there, and the future is bright. What I want to emphasise is that we can do even better.”

1997



**MAHAD SAEED: STUDENT MECHATRONICS SYSTEMS ENGINEERING AT HOCHSCHULE KLEVE**

Mahad studies Mechatronics Systems Engineering at the Rhein-Waal University of Applied Sciences in Kleve, Germany. He attended the minor Semiconductor Packaging at HAN, and will soon start his first job at the Chip Integration Technology Center (CITC). In his opinion, this was one of the best decisions he has made in his academic career so far.

**Why do you feel like studying mechatronics systems was one of your best decisions so far?**

“I had a broad idea about semiconductors before coming to Nijmegen for the minor. But I didn’t know anything about the manufacturing aspect. When I was still looking for an internship, our university offered the minor. To learn more about it, I contacted a senior who attended the minor the year before. He was very positive!” It was also at this time in my studies, that I felt I had to learn something I could use later on in my career. The senior student warned me that this minor meant less partying and more studying. Not your normal exchange student life, where people go to Spain for sangria. But I liked the idea of getting this knowledge. Combined with the news about the chip shortage, I was certain there would be much work in this field.”

**“Starting in this field can be pretty scary: everybody is so intelligent!”**

**What was it like to begin working in this sector?**

“Starting in this field can be pretty scary. Everyone you speak to is highly intelligent; most of the time, these people have been working with chips for years. But I learned you need some patience: the seniors want you to succeed too, because they are passionate about this industry.”

“When I began working, I didn’t have a lot of experience in the field yet. However, because my father was an engineer I was always around circuit boards as a kid. Very different from chip packaging, yes. But I’m not surprised about my interest! In my bachelor, there were some courses about analogue electronics. These courses were highly theoretical, and I didn’t enjoy them. During the packaging minor, I saw things in a different light. What does a chip do, how do we design it optimally, and what are the best options?”

**What do you think about your future in the Dutch chip industry?**

“I think the Netherlands play quite a crucial role in the European chip industry. Everyone talks about corporations like NXP and ASML. Prior to the minor, I didn’t know that the supply chain in the chip industry was so convoluted. It’s more a network than a chain. There are a lot of important countries in that supply chain. The US, Thailand, Malaysia and Taiwan. But the Netherlands is up there. For Europe, this country is way more important than Germany, for example.”

**“The Netherlands are crucial to the European chip industry.”**

“For the future, I see many opportunities in photonics. Physical limitations are holding back the further development of electrical chips. We need a lot of research, which is great news for me. We didn’t solve the chip shortage yet, so there is a lot of ground to cover. The industry needs more people, which means that there are a lot of opportunities for people from my generation. This year may be all about AI and neural networks, but let’s be realistic. Changes in the world of chips, will trickle down to all other industries. We are the base of all other fields, because computers run on chips.”