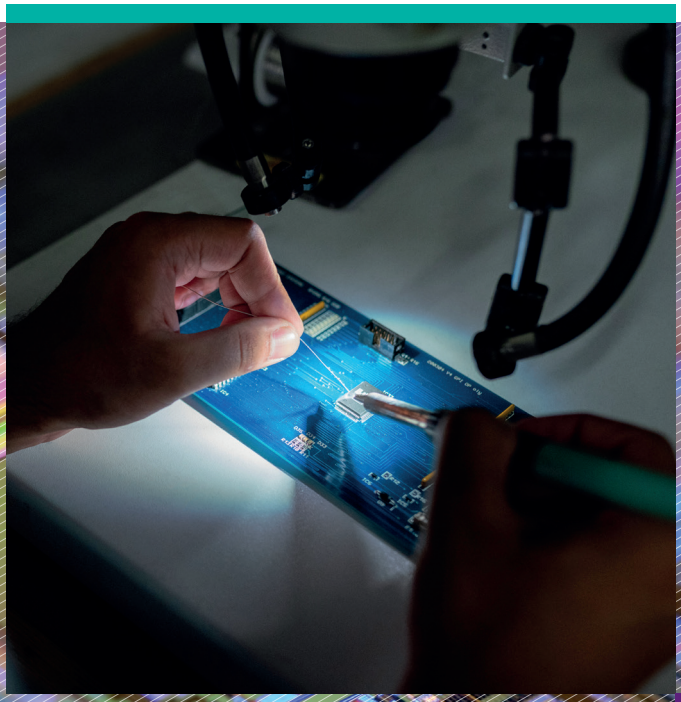


CHIPTECH TWENTE

EUROPE'S GATEWAY FOR INNOVATIVE CHIP DESIGN AND HETEROGENEOUS SYSTEMS

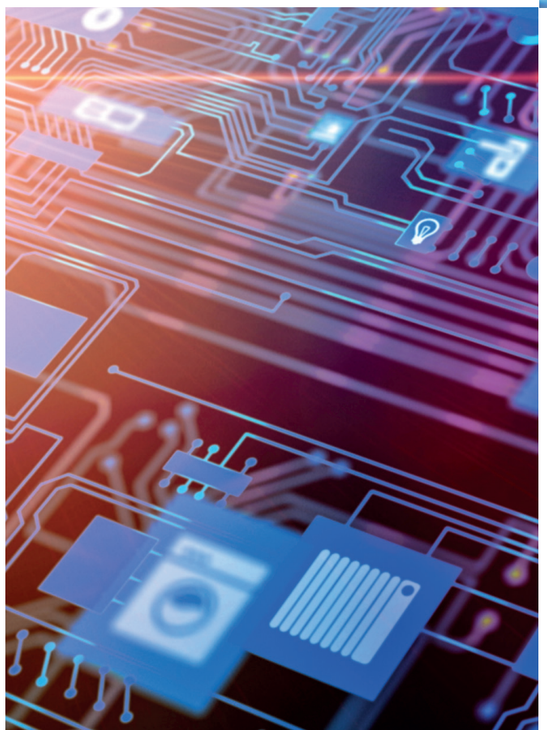
Chips are becoming increasingly important in our society. They are an indispensable component in almost all of our devices at home, but also in cars, medical equipment, modern production processes and security systems. The worldwide shortage of chips and the impact of that shortage on our economy, our independence and on our security has prompted the European Union initiate the Chips Act: an ambitious plan to increase chip production in Europe and thereby reduce our dependence on Asia and the US. Twente has a strong semiconductor cluster and is eager to contribute to the issues identified in the European Chips Act. But this requires investments and actions.

CHIPTECH TWENTE

CHIPTECH TWENTE: A STRONG CLUSTER

Twente is on the national and international map as a hotspot for semicon and specifically for analogue chip design, photonics and as an important supplier to ASML. With a strong Integrated Circuit Design department at the University of Twente headed by professor Bram Nauta, the MESA+ institute and around 50 semiconductor-related SMEs, customers worldwide benefit from the unique knowledge of Twente. These companies have one thing in common: they all work closely with the University of Twente and Saxion University of Applied Sciences, which have a long and impressive history and a strong international scientific track record in the fields of electrical engineering, microelectronics, nanotechnology, photonics, quantum technology and microfluidics.

The chips that roll out of the wafer fabs of Taiwanese company TSMC and – more closely at home - NXP are designed by Twente companies such as Bruco, Axign and the Twente design departments of multinationals Cyient and Teledyne-Dalsa. But chip design is not the only component that is strongly represented; other parts of the semicon cluster are also strongly anchored in Twente and the Eastern Netherlands, including the MESA+ institute of the University of Twente, Salland Engineering, IMS, Bronkhorst High-Tech, test centre Eurofins | MASER and equipment company Solmates. From Twente we supply components to ASML, but more importantly we have state-of-the-art analogue and RF chip design companies, digital chip design companies, (integrated) photonics and microfluidic MEMS, packaging companies and companies that integrate these chips and MEMS



into products for the automotive, healthcare and consumer electronics markets. Strong growers in photonics and microfluidics include companies such as Micronit, Lionix International and Quix.

What makes Twente strong is that we are a region with a strong concentration of innovative and knowledge-intensive SME companies, a high degree of cooperation between the universities and these companies and a close cooperation between the companies themselves. Short lines of communication and an entrepreneurial spirit guarantee a high rate of innovation, crossovers and collaboration. Moreover, these SMEs are often still **in Dutch or European hands**; an important advantage in the pursuit of more mutual dependencies between the continents in the chip industry.

CHIPTECH TWENTE

WHAT MAKES TWENTE UNIQUE:

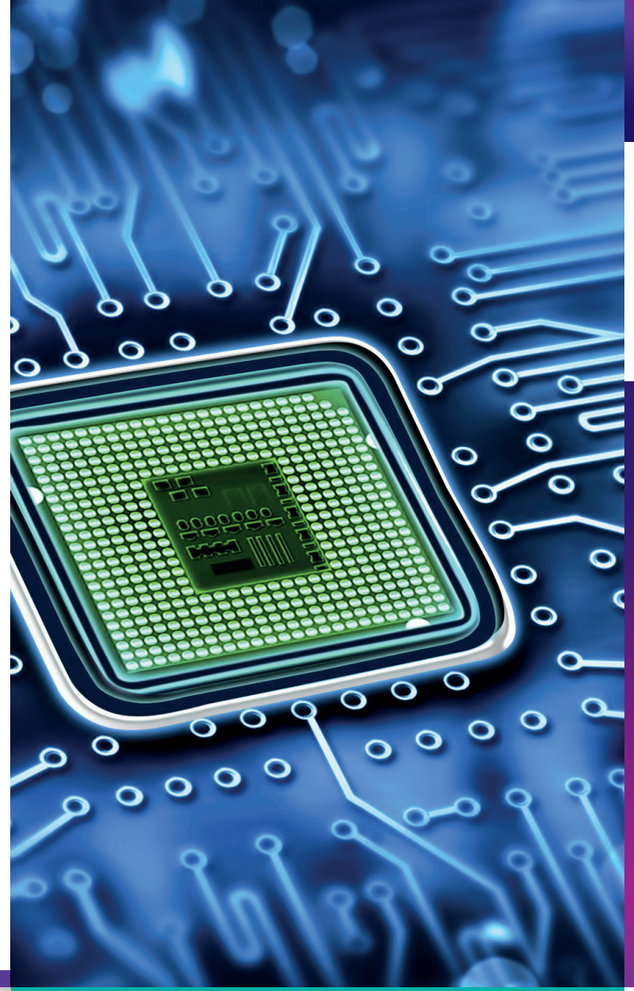
- ☑ **Having independent companies in chip design.**
- ☑ **A strong Integrated Circuit Design department, with a focus on analogue, RF and mixed signal design, and a high stayrate of talent in Twente.**
- ☑ **A strongly growing photonics cluster.**
- ☑ **The MESA+ institute in which more than 600 scientists work on new technologies in the field of, among others, semicon, photonics and quantum technology.**
- ☑ **The MESA+ Nanolab as a place where science and companies work together on new technology.**
- ☑ **Companies that are able to develop unique solutions for customers and each have their own specific knowledge.**
- ☑ **Companies and knowledge institutions that continuously seek new combinations and continue to innovate.**
- ☑ **A strong network in which companies, scientists and talent can quickly find each other. As a result, talent is retained for the region (and the Netherlands!).**

TWENTE EMBRACES EU CHIPS ACT ‘STRENGTHEN IN WHICH WE ARE STRONG’

The European Chips Act is highly appreciated in Twente, because we believe that investing in knowledge, research and development in the European semicon sector is the only way to keep the global scale and dependence in the semicon industry in balance. In Twente we are sure, that we can help realise the dream of the European Commission to increase our market share to 20% of the world market. However, we do not believe that Europe, Asia or the US can ever be self-sufficient or fully independent when it comes to the design and production of chips. The interdependence of the knowledge in Europe, the factories in Taiwan and the US and the machines of European companies like ASML is too great. What we can do is ensure that the scales stay balanced. That's why we think the Chips Act should focus on strengthening what is already strong in Europe: **innovative chip design, high-end production equipment and close collaboration between design and use cases.** Would we like to have a factory like TSMC or Intel in Europe? Of course we would. But not at any price and not just a factory. The orders for such a fab would mainly be filled by customers outside Europe, leaving little added value for Europe. That is why we think Europe should invest further in its (fabless) design houses, in innovative technologies such as photonics and quantum, and we see opportunities for Twente to become the European hotspot for a new generation of heterogeneous chips.

OUR AMBITIONS

In Twente we can make an important contribution to the ambition of this new generation chips, to strengthening our strengths and to reducing our independence on Asia and the US. Especially in Twente we can do that. After all, the breadth and combination of (enabling) technologies such as electronics, photonics and microfluidics is a major challenge. How can we optimally combine analogue and digital signals? How can we use the knowledge and experience in electronic chips for the further development and application of photonic chips? How can we stack electronic, photonic and microfluidic components into a single design, so that, for example, we can use the screen of our smartphone as a high-speed corona test? Or how can we use electronic chips embedded in labels to predict the shelf life of food by measuring temperature changes; use photonic devices to look inside the food to see how ripe it is; and use microfluidic systems to measure vitamin content and then use the computing power of electronic chips to send the food to the right processor based on that information? It is particularly from the combination of different technologies that innovation emerges and that we can contribute to social challenges.



With the MESA+ Nanolab, we have experience with good cooperation between science and industry in the cleanroom.

CHIPTECH TWENTE

MESA+ VS PURE PLAY FOUNDRY

The MESA+ Nanolab plays an essential role in the Twente ecosystem of research and business. Science and business literally and figuratively meet in the lab. However, due to the growth of companies, it is also becoming increasingly busy in the lab. Research has priority and therefore companies sometimes have to wait a long time before it is their turn. By realising a Pure Play Foundry in which companies are at the forefront, but where science is of course also welcome, the pressure on the MESA+ Nanolab is relieved and companies can produce close to home.

From the PhotonDelta Growth Fund application, funds are available for realising a silicon nitride plant, where photonic chips in particular can be produced. The NEXTGEN High Tech application contains funds for realising the tools (machines) for heterogeneous systems. With additional resources from the Chips Act, a Pure Play Foundry for heterogeneous chips could be realised.

3 CHIPTECH TWENTE AMBITIONS

To realise this ambition, action and investment power are needed. That is why we are focusing on three priorities in Twente:

AMBITIONS OF CHIPTECH TWENTE

1. **CONTINUED INVESTMENT IN ELECTRONIC CHIP DESIGN**
2. **RESEARCH PROGRAMME FOR INTEGRATION HETEROGENEOUS SYSTEMS**
3. **REALISATION OF HETEROGENEOUS FAB**

1. CONTINUED INVESTMENT IN ELECTRONIC CHIP DESIGN

The European Commission wants to invest in the next generation of chips. We fully support this and would like to emphasise that Moore's Law will remain in force for the coming decades: there is still plenty of room for innovation in analogue and electronic chips. We see photonic chips often described as 'the next generation of chips', but photonic systems will always need an electronic chip for their computing power and their connection to applications. They are therefore not the successor to electronic chips but an interesting extension. Unfortunately, in the Netherlands microelectronics is not designated as a key enabling technology by the Ministry of Economic Affairs. As a result, much less money is available for (fundamental) research. It remains necessary to invest in research projects and to educate the necessary talent. If we do not reinforce (or consolidate) our position now, we will lose out in the future. Within the EU Chips Act, much attention is paid to solving chip shortages. We are not going to solve that problem in the Netherlands in terms of production, but if we do not strengthen chip design talent, we will not be able to solve the chip shortage in Europe at all. Investing in electronic chip design and fundamental and applied research is therefore an absolute must. By investing in this, we largely guarantee our independent position in Europe.

2. RESEARCH PROGRAMME FOR INTEGRATION HETEROGENEOUS SYSTEMS

In recent years, much has been invested in photonics. Photonic chips have properties that are of great importance for data storage and telecommunication. Photonics companies that can design and produce this new generation of chips have emerged in Twente and Eindhoven. The granted Growth Fund application PhotonDelta will contribute to the further approved of the production capacity of photonic chips in Twente. But we are already looking further. The future of chips does not lie in electronic or photonic chips, but in the integration of systems. The NXT GEN HIGHTECH growth fund application plays a major role in this, in which the next generation of equipment for integration and packaging is being developed. Europe should invest in building up knowledge about these integrated systems and the machines needed to produce them. Twente is the ideal place for this. We have all the key technologies in-house: from analogue mixed signal and RF design, photonics, quantum photonics, microfluidics, materials, thin film application and advanced manufacturing. It is precisely this combination of all these technologies that is needed to not only design heterogeneous chips, but also to build the machines to produce them. **We want to use the coming months to draw up a research roadmap for the development of heterogeneous systems.**

3. REALISATION OF A HETEROGENEOUS FAB

The Chips Act aims to fund 'first of a kind fabs'. A fab for heterogeneous systems fits in with this European ambition. Since heterogeneous chips are in an early phase of development, we see in Twente an excellent opportunity for pilot manufacturing these heterogeneous chips. We have the ambition to grow towards large-scale production. With the MESA+ Nanolab, we have experience with good cooperation between science and industry in the cleanroom. We want to use this experience to take the next step and set up a foundry where electronic, photonic and soon also heterogeneous systems can be produced. In Twente, we believe in challenge-based innovations, close to the market, but always at the forefront of what is scientifically and technically possible.

TALENT IS KEY!

The greatest obstacle for growth for the companies in the ChipTech Twente cluster (and beyond!) is a lack of talent. In order to increase the European market share to 20%, education and training of talent are crucial. The field of microelectronics and chip design requires very specific knowledge. We need to attract more national and European students to this industry. We will also need to attract talent from outside Europe, but we must ensure that the knowledge and skills they acquire here remains in the European ecosystem. By investing in the scientific staff and the number of PhD positions in the field of Integrated Circuit Design, the number of Master's students can also grow. In addition, Europe can invest in scholarship programmes for European students and offer master classes to interest secondary school students in these fields of study.


BRAM NAUTA

CHIPTECH TWENTE IS KEEPING TALENT IN TWENTE

The University of Twente produces a considerable number of graduates in Integrated Circuit (Chip) Design, who are very attractive for companies to hire immediately after graduation. As a result, approximately 9 chip design companies are currently located at the Science Park Kennispark Twente and close to the university. In the area of research, Professor Bram Nauta works with Twente's design houses and industries from all over the world, providing them with knowledge and smart design solutions. At the same time, he creates employment for his graduating students. Most of 'his' students now stay in Twente, because there are several Twente design houses and therefore enough 'choice' for these talented designers. Whereas a few years ago talent chose the Eindhoven region or even Silicon Valley, it is now the other way round: chip design talent from other cities comes to Twente because of the cluster of design companies that offer them sufficient career opportunities and an ecosystem in which they can thrive.

INVESTMENTS FROM THE CHIPS ACT

We ask the European Union (and the national government) to **invest in electrotechnical education and research facilities**, where talents in chip design and chip development are educated. By strengthening the research and teaching capacity, more students can be admitted. And by giving European students EU scholarships, we can ensure that more students stay in Europe and use their knowledge to strengthen our economy and independence.
We hope that the Chips Act will open up funds to promote studies such as electrical engineering in secondary schools, for example by organising summer schools or assignments for secondary schools. Specific research funds for chips should also be allocated. PhD students at the university are the backbone of research and talent development. They carry out industrially relevant research in cooperation with industry. They supervise MSc students in their projects, and after graduation they all go to work in the industry. **More research resources results in more PhD students feeding the ecosystem**.

INVESTMENTS FROM THE CHIPS JOINT UNDERTAKING

The Chips Joint Undertaking is an instrument that we believe is suitable to strengthen research and development in the field of semiconductors in Europe. It is not always easy for SMEs to participate in these projects. We therefore recommend that within the total budget for the Chips Joint Undertaking, **a part should be reserved for SMEs** or that the regulation should require cooperation with SMEs in order to submit an application.

ACTIONS FROM CHIPTECH TWENTE

In addition to the investments requested by the Chips Act and the Chips Joint Undertaking, we are of course also working hard to realise our ambitions. In the upcoming period, we will be working on the following:

- Composing a roadmap for achieving our ambitions.
- Improving the match between the study programmes of Saxion University of Applied Sciences and the University of Twente.
- Attracting more students to study Electrical Engineering at Saxion or the University of Twente.
- Seeking cooperation with other colleges and universities (joint degree).
- Attract alumni from all over the world back to Twente (and therefore the Netherlands and Europe).
- Helping chip design companies to identify their growth opportunities (for supplying complete systems) and investing in the expansion of these companies with the help of business developers. This requires capacity and an investment fund.

CHIPTECH TWENTE SUCCESS STORIES

The strong ChipTech Cluster in Twente did not happen overnight. Decades of scientific research, innovations and the ability of building strong companies are now paying off. An overview of groundbreaking successes from Twente.

Own amplifier, Axign
As a chip design company, Axign has succeeded in bringing its own products to the market. The patented audio amplifiers for JBL and Harman Kardon, among others, were designed by Axign's chip designers and produced in Nijmegen. A thoroughly Dutch product.

Revolutionary optical system, Micronit
A second ESA project is Athena. The project aims to study very hot and energetic phenomena in the universe using the Athena X-ray telescope. This telescope is equipped with mirrors: a revolutionary optical system in which stacked thin sheets of silicon act as a lens that directs the captured X-ray light to the spectrometer and camera. Micronit, specialist in microfluidics, lab-on-a-chip and microtechnology, is developing the silicon plates and the necessary processes to make this revolutionary optical system, together with its client Cosine. The mirrors are produced in Micronit's cleanroom in Enschede.

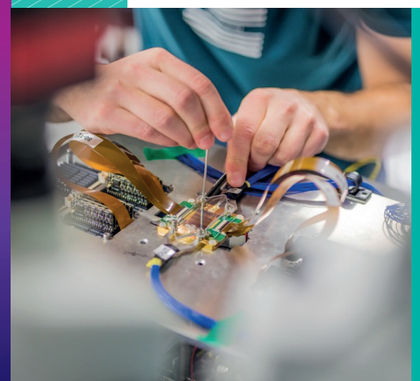
Chip design Tomcat, QBayLogic
Digital chip designer QBayLogic made an important contribution to the laser solution of the consortium consisting of Esa, Airbus, TNO and Demcon for the Tomcat project. The goal was to develop an optical ground station, including an optical ground terminal. This terminal had to receive laser signals from a satellite, which on their way are influenced by atmospheric conditions that cause distortions of the beam. Twente's engineering company Demcon asked QBayLogic because of its design methodology for high-level FPGA programming. The successfully designed and applied chip has both analogue and digital aspects. A follow-up to this project will be launched shortly.

Microsystem Solutions, LioniX International
LioniX International is a global supplier of customised microsystem solutions, specialising in integrated photonics and MEMS devices. They manufacture Photonic Integrated Circuit (PIC) modules, based on their patented waveguide technology - TriPleX™. This silicon nitride platform offers ultra-low losses and a wide spectral range, enabling various applications. They also supply custom MEMS for instrumentation, life sciences and space markets.

Motion sensors, MEMSIC
MEMSIC designs motion sensors that automatically adjust the screen of your device. Think of actions when you turn your phone and by the use of pedometers. Their chips are used in products by Google, Vivo, Garmin, Samsung and Microsoft, among others. They also work closely with global player in sensoring Xsens (Movella), also based in Enschede. Xsens develops systems that use MEMSIC-designed chips, such as accelerometers and gyroscopes. The chips are combined MEMS and ASIC (Application Specific Integrated Circuits).

Measuring patient data, Sencure
Sencure develops chips with which electrophysiological parameters of the human body can be measured in an innovative way. The aim is to have as little impact as possible on a patient's daily life. They bridge the gap between compliance and the best solutions for wearable health.

MEMS mirror autonomous driving, Bruco IC
LIDAR is crucial to the success of advanced driver assistance (ADAS) and autonomous driving. Light is used to scan the environment with all relevant objects. Bruco designed an integrated circuit for advanced driver assistance (ADAS), based on MEMS mirror technology. Their IC controls and drives the MEMS mirror. The challenge for this chip was to accurately detect the position of the mirror. By allowing actuation and sensing to use the same capacity of the mirror, a smaller mirror size and an enormous cost reduction could be realised. The MEMS mirror is patented.



Photonic quantum computer, Quix Quantum

QuiX Quantum is the market leader in photonic quantum computer hardware and recently launched the world's largest photonic quantum processor. The processor, which was developed at QuiX's factory in Enschede, performs almost 2 times better than the current generation of processors. The new photonic quantum processor has a record number of qumodes (20), and the highest operating specifications on the market. They are truly pushing the boundaries of photonic quantum computing.

"Everything we see as science fiction now, the things we consider to be absurd and impossible to do, will be made in the future. I am convinced that we will continue to make electronics faster, cheaper and smaller, in order to change the world."

Prof. Dr. Ir. Bram Nauta
Electrical Engineering, University of Twente

CHIPTECH TWENTE

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ChipTech Twente works closely with Holland Semiconductors, the University of Twente, Kennispark Twente, MESA+, the province of Overijssel, Oost NL, Twente Board Development, Novel-T and various SMEs.