EINDHOVEN ENGINE FUELS FRESH STARTS IN INNOVATION

At just over a year old, Eindhoven Engine has already produced a large number of appealing projects. The driving motivation behind this initiative in innovation stimulation is to create an inspiring atmosphere comparable to that of the famous Philips NatLab (Philips Research). Here, clever scientists were more or less free to investigate innovative ideas in close cooperation with colleagues and product designers.

FRANS ZUURVEEN

In 1914, Gilles Holst started work in Eindhoven (NL) as a physics researcher. His tasks were the development of new Philips products, like radio valves, and the improvement of existing ones, mainly incandescent lamps. Holst had recently left Leiden (NL), where he had been collaborating with Heike Kamerlingh Onnes, who had just succeeded in producing liquid helium, reaching a temperature of nearly 0 K.

The work Holst supervised in Eindhoven as director of NatLab ('Physical Laboratory') included gas discharge, radio and X-ray tubes, magnetic ferrites and television. He had good intuition for which phenomena to investigate in the continuously expanding NatLab. Before the Second World War, however, he made a 'misjudgement' in his decision to favour film and cheap consumer cameras instead of predicting a future for the new medium of television. Nonetheless, this misconception led Philips to the successful production of film projectors and even the much less successful recording of a feature film.

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The former NatLab lecture theatre at the Eindhoven Kastanjelaan. (Photo by Johan Bakker [1], 2017)

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The NatLab atmosphere

Before, during and after the Second World War, the NatLab was housed in premises at the Kastanjelaan in Eindhoven. Prominently visible from outside is the lecture theatre (see Figure 1), where every Thursday young scientists, after having been at Philips for a year, used to give an insight into their research ambitions. In the sixties, the NatLab moved to premises on Philips grounds south of the city of Eindhoven, where the High Tech Campus is now located. Characteristic for an atmosphere facilitating the easy exchange of ideas and opinions between people were the large restaurant and the goose pond. After lunch, NatLab workers used to make a short walk around the water, often explaining problems concerning their work and providing colleagues with the opportunity to suggest solutions.

The other end of the terrain housed the Philips Patent Office. Scientists discovering a new invention presented their findings to the NatLab directional board with a so-called white card. After permission was given by the appropriate member of the board of directors, the card was transferred to the Patent Office to formulate a patent application. Of course, only a small fraction of ideas led finally to a commercially available Philips product, but in an annual assembly of the CEOs of Philips and American Bell Labs, the Philips patents did help the company to acquire the formal right to exploit relevant American discoveries.

Eindhoven Engine

Fast forward to 2020 and the directors of Eindhoven Engine, Maarten Steinbuch and Katja Pahnke, who are responsible respectively for the technical and operational aspects. They have this to say about the initiative: "Co-creation and co-location are the basic ingredients for unleashing the collective intelligence in order to boost innovation." Their

2 The TU/e MultiMedia pavilion, housing Eindhoven Engine.

aim is to recreate the NatLab atmosphere described above by supplying the means for opportunities to innovate to scientists, companies and engineers, and now also students from both Eindhoven University of Technology (TU/e) and Fontys University of Applied Sciences.

The basic location for Eindhoven Engine is the MultiMedia pavilion on the TU/e campus (see Figure 2). The building has undergone intense and rigorous modification to suit the demands of an interactive exchange of ideas in and around the various Eindhoven Engine projects. The opening and inauguration of the renewed building was planned for 10 December, 2020, the current state of the Covid-19 pandemic permitting.

The people working in Eindhoven Engine originate from various companies and knowledge institutes in Eindhoven Brainport, the ecosystem based in the region's high-tech systems industry. They generally spend at least one day a week in the Eindhoven Engine building. The interaction of ideas and results is stimulated by, among other things, the organisation of regular meetings comparable with the Thursday morning meetings at the former NatLab, and also cross-project team meetings. Many projects have a larger quarterly meeting, giving them the opportunity to release progress reports. Naturally, interactions between projects through workshops, etc. are of vital importance. The general

Piezo-electric wafer stage

ASML is greatly interested in innovative ideas for the precision movement and positioning of wafers in their advanced wafer scanners, which work with ultrashort-wavelength EUV illumination (see Figure 3). Moving and positioning a 12-inch wafer, with a positioning reproducibility in the nanometer region, has up until now been achieved in two stacked stages: one for a 'rough' long-stroke movement and one for a highest-precision short-stroke movement. Originally, the long-stroke stage consisted of an H-form configuration: two Y-guides for the movement of one X-guide that bears the short-stroke wafer carrier. This century, this H-configuration has been replaced by a planar actuator stage, designed as a big electromagnetically levitated box. The Eindhoven Engine project aims at a new concept for the short-stroke stage. The present design has the disadvantages of high mass, disturbing magnetic fields and high actuation forces in a mechanical system structure with limited stiffness. The idea is to investigate how piezo technology could help to achieve mass reduction (5 kg instead of 20 kg, for example) in compact and stiffer short-stroke actuators. A successful design also might be applied in future ASML wafer inspection machines.

Partners: ASML, TU/e High Tech Systems Center, with the later involvement of NTS, VDL ETG and TNO.

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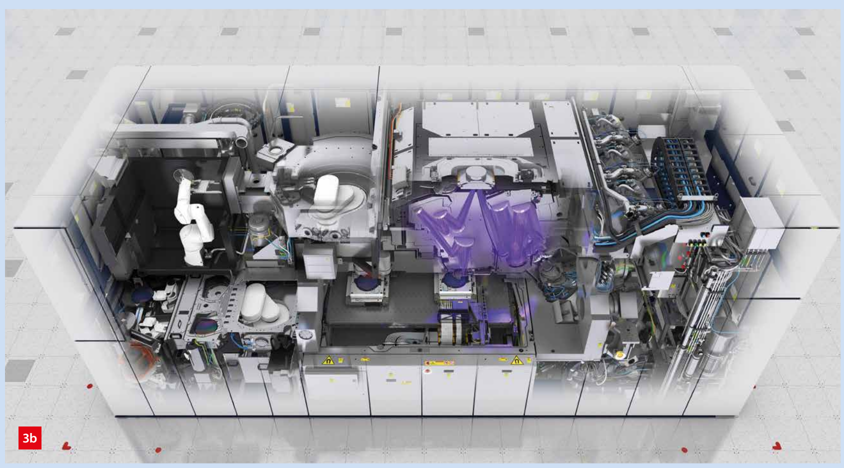

3b

An ASML EUV wafer scanner. (Images courtesy of ASML)
(a) Opened front view with EUV beams in yellow.
(b) Opened top view with EUV beams in purple.

exchange of knowledge is also facilitated via the physical set-up of the building: there are no closed private rooms. Instead the space consists only of open connections to stimulate the consultation of colleagues.

More than 16 projects have already been approved by a team of experts. New OpenCall projects will be launched in the coming years. The blue boxes highlight three current projects with precision engineering interfaces.

To conclude

Time will tell whether the recreation of the NatLab atmosphere has helped to stimulate innovation in the Eindhoven Brainport region. We will continue to scrutinise what happens there in the world of precision engineering.

REFERENCE
[1] *nl.wikipedia.org/wiki/Philips_Natuurkundig_Laboratorium*

INFORMATION
WWW.EINDHOVENENGINE.NL

Efficient air quality

The aim of this project is to improve the efficiency of clean-air production, because air installations are responsible for around 35 per cent of all energy consumption in buildings. Ultimately, this should benefit schools, because inferior environmental conditions within classrooms have both short- and long-term health effects due to tiny particles in the air.

A spin-off of this schools-directed project may target cleanroom design. Many precision-engineering products can only be manufactured under cleanroom conditions (see Figure 4). Every cubic meter of untreated outdoor air typically contains 35,000,000 particles of 0.5 µm and larger. In contrast, ISO 1 cleanrooms should have no particles of that size at all. The investigation of sensors, filters, ventilators and air control systems in this project may help to reduce energy consumption in the assembly of high-tech equipment.

Partners: Building G100, Camfil, ISSO, Kropman, Lucas Onderwijs, NedAir and TU/e.

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An ASML technician working on a wafer scanner in a high-grade cleanroom. (Photo courtesy of ASML)

SmartMan

Smart manufacturing, SmartMan for short, is a rather well-known activity within the high-tech systems industry that involves the optimisation of factory efficiency by improving production processes. However, SMEs generally lack capacity to create innovation in this area. By offering student resources and experience from comparable previous cases, Fontys University of Applied Sciences is able to help SMEs to innovate, with TNO filling in the strategic directions of smart manufacturing. This includes aspects such as robot-assisted manufacturing, data sharing, industrial artificial intelligence, virtual reality and autonomous transport. One important objective of the project is to stimulate Fontys students and graduates to become active in this project by integrating quality control, automation and flexibility on existing shop floors. The ultimate goal is to create a community of SMEs that support each other on innovation issues.

An interesting SmartMan activity is the collaboration of Fontys, Siemens Nederland and Bozhon Precision Industry Technology. This involved the creation of a virtual digital twin of a machine with robot arms for the industrial connection of the front and back sides of smartphones (see Figure 5). A saving of 30 per cent in development time was achieved by simulating the specified machine using this virtual 3D model, including an interface with the open, cloud-based operating system MindSphere. During the real manufacturing of the machine in China, functional tests could be executed at the virtual twin machine in the Netherlands.

Partners: Fontys, TNO and Smart Industry fieldlab partners VDL, VBTI and several SMEs.

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A Bozhon precision mounting machine for the connection of smartphone parts. The development time for this machine was reduced with the aid of a digital twin. (Image courtesy of Siemens Nederland)