100 years of innovation in Heerbrugg

The company "Heinrich Wild, Werkstätte für Feinmechanik und Optik" was founded a century ago in Heerbrugg, Switzerland, on 26 April, 1921. Over the decades, this company developed into the world-renowned Leica Geosystems AG and is an essential component of the Hexagon technology group. The founder, Heinrich Wild, was a master of innovation. He revolutionised surveying with smaller, more practical, yet more accurate instruments. Heerbrugg has repeatedly been the source of major innovations, such as the first optoelectronic distance meter in 1968, the first electronic theodolite with digital data recording in 1977, the first surveying system based on GPS signals in 1984, the first digital level in 1990, the first hand-held laser distance meter in 1993, the first digital aerial-image sensor in 2000 and the smallest, lightest and most user-friendly laser scanner in 2019. What was the recipe for success in this hundred-year history of innovation?

E. Voit

A difficult start

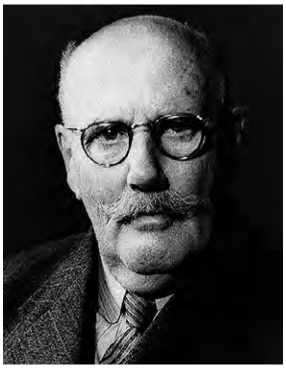
The structural crisis in the embroidery industry in the early twenties of the last century hit Eastern Switzerland and especially the Rhine Valley so hard that its impact even exceeded that of the global economic crisis that followed ten years later. Because the major Rhine-regulation projects were coming to an end at the same time, new work was urgently needed for the people of the Rhine Valley.

After working for the Swiss Federal Topography, Heinrich Wild, a native of Glarus, had built up the geodetic department as chief engineer of the Zeiss-Werke in Jena, Germany. He already had a reputation as a brilliant inventor in the surveying world. Because of the uncertain future after the war and the constant devaluation of money, he wanted to return to Switzerland with his family of ten. With design plans of geodetic and photogrammetric instruments in mind, he looked for partners in Switzerland to found an optical precision-mechanical experimental workshop. He remembered his fellow officer Dr. Robert Helbling in Flums, who, as the owner of a well-known surveying office, would be very good at assessing the market needs. Helbling knew Jacob Schmidheiny, an industrialist from the Rhine Valley, from their time studying together at the ETH, and he quickly took a liking to the project. As a successful entrepreneur, he had the right sense of purpose and the necessary money. Heinrich Wild repeatedly pointed out that precision-mechanics specialists would be available in the area of the watch industry. But for Jacob Schmidheiny, one guiding principle was clear from the start: work for the people of the Rhine Valley.

On 26 April 1921, the three signed a contract to found a simple company under the name "Heinrich Wild, Workshop for Precision Engineering and Optics, Heerbrugg". A site was acquired from the municipality of Balgach, and by the end of 1921 the first building was already completed, in which initially five to ten people were employed. At the same time, a former embroidery factory was bought across the Austrian border in Lustenau, just seven kilometres away, and a workshop was set up for 30 to 40 people. At first, it was mainly the skilled workers that Heinrich Wild had brought with him from Jena or would recruit in future who worked here. This was mainly because Switzerland was very restrictive with work permits in this post-war period, which was marked by unemployment.

The production of Heinrich Wild's new level started, but many of his innovative ideas and designs were not yet technically mature in 1921. After a year, the company's capital had already been exhausted, even before the first instruments went on sale. In 1923, the company got an injection of new capital through the foundation of the "Verkaufs-Aktiengesellschaft Heinrich Wilds Geodätische Instrumente Heerbrugg" (Heinrich Wild's Heerbrugg Selling Company for Geodetic Instruments). On a commission basis, this joint-stock company provided credit and obtained orders for products of the simple company, which continued to exist.

However, the lean period was long and



Heinrich Wild
1877 – 1951
The inventor

Jacob Schmidheiny
1875 – 1955
The financier

Dr. Robert Helbling
1874 – 1954
The practitioner

Fig. 1: The three founders – a perfect combination of inventiveness, entrepreneurship, and market knowledge.

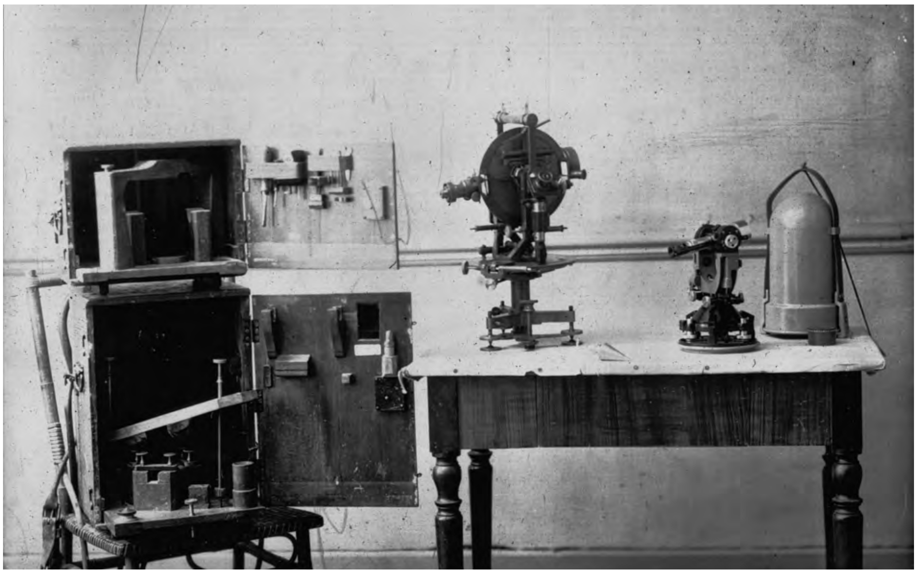


Fig. 2: The small Universal Theodolite WILD T2 did the same job as triangulation theodolites of previous designs. It was three times lighter and despite its compactness, more accurate, more reliable, and several times faster. With these characteristics, it was set to revolutionise the entire surveying world.

technical problems in productisation were coupled with a shortage of optical and precision mechanical specialists. Heinrich Wild's vision of a small, compact universal theodolite proved extremely difficult to realise. Thus, in 1924, only 27 of the planned 350 T2 theodolites were actually completed. It was not until 1929 that the company was on safe ground and was able to pay out a dividend for the first time.

The second product area for which Heinrich Wild's inventions laid the groundwork was photogrammetry. This made it possible to produce accurate maps very economically, such as the then-new Swiss national map. WILD's phototheodolites, autographs and aerial cameras quickly gained a reputation worldwide.

Fig. 3: The first C2 aerial camera was delivered to the Swiss Federal Topography in 1927.

The test workshop becomes a company

The streamlining of the company organisation and the establishment of a worldwide sales network by the new director Dr. Albert Schmidheini, appointed in 1925, brought about a first expansion phase with 250 employees in 1930. This expansion was interrupted by the economic crisis of the 1930s, but in 1933 there were still 130 employees. Then, however, a second phase of expansion set in, increasing the workforce from just over 200 in 1936 to more than 1000 in 1941. It remained at that level until 1951 and then continued to rise steeply. The three-thousand mark was exceeded in October 1961.

The inventive genius leaves the growing company

Around 1930, differences of opinion made themselves increasingly felt, and Heinrich Wild and his family moved from Heerbrugg to Zurich. He rarely came to the Rhine Valley anymore, and communication became more and more difficult. In 1933, he left the company and went into business for himself as an inventor and designer. Heerbrugg continued to commission him until 1935, when he signed a contract with Kern & Co in Aarau; he remained loyal to Kern until his death in 1951. However, the name "Wild" remained omnipresent in the company name and in product names until 1990, when the Leica era began. But even long after 1990, for the people of the Rhine Valley "Wild" is still synonymous with the Heerbrugg factory.

The increasingly threatening political situation in the 1930s triggered a need for military instruments in Switzerland too. In record time, prototypes of telemeters, telescopic sights, omnidirectional telescopes and instruments for artillery units were developed, built and demonstrated in Bern. As a result of this successful activity, WILD became one of the main suppliers of the Swiss Army and expansion began again in Heerbrugg.

Skilled workers in short supply

At the beginning, the acute shortage of skilled workers in the optical and precision-mechanics sector was countered by recruiting appropriate personnel from the optical centres of the time – namely those in Jena. At the same time, however, a start was made from day one on recruiting and training Rheintalers for such tasks. As early as 1921, two apprentices selected personally by Heinrich Wild began their apprenticeship in Lustenau. To be able to provide even more targeted training, the company's own dedicated apprentice-training school was founded in 1924. In 1930 this became the Fachschule für Feinmechaniker und Optiker, the Technical School for Precision Mechanics and Opticians. In 1958, the entire apprenticeship training including the company's own training school moved into a new building constructed specifically for this purpose. At any given time, around 300 apprentices were always in training at WILD.

Fig. 4: The apprenticeship department of WILD in 1930.

The culmination of the precision-engineering epoch

In 1943, an old idea from the time the company was founded was revived, and WILD drawing instruments were brought onto the market. The impulse for this was not least the Kern DKM1 theodolite, which bore the inscription "Construction Dr. H. Wild" despite protests from Heerbrugg.

The T4 astronomical theodolite was the absolute pinnacle of optomechanical precision when it was launched in 1944. This instrument enabled a direct reading of 0.1" with an accuracy of ±0.3" – still legendary today.

At an early stage, WILD also began collaborating in international research partnerships. In 1952, for example, the BC-4 ballistic camera, developed together with the Ballistic Research Center in the USA, went into production. This camera combined the high angular-measuring accuracy of the T4 with the high resolution capacity of the special aerial-imaging lenses. The BC-4 camera would later also be used for satellite triangulation and thus for the construction of the first global positioning system.

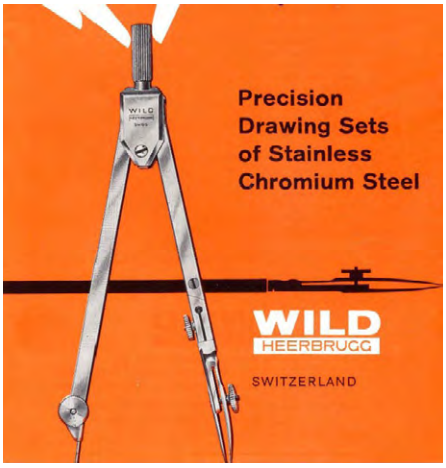


Fig. 5: The WILD drawing instruments launched in 1943 first had to assert themselves against the established Kern products. In 1972, production was finally discontinued and the German company Riefler continued to manufacture and market the instruments under license.

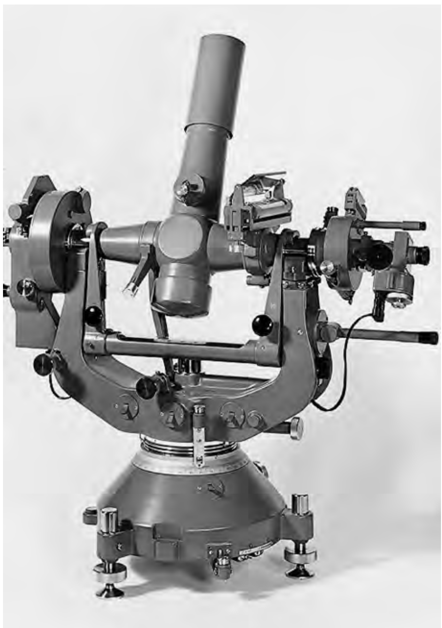


Fig. 6: The T4 astronomical Theodolite was designed by the talented constructor Edwin Berchtold. He began work in Heerbrugg in 1928 as the first ETH graduate engineer.

Optical flights of fancy

In 1947, WILD continued its pioneering work in the field of microscopy. The first research microscopes produced in series in Switzerland, the M9 and M10, had their market launch. Hans A. Traber, born in 1921, joined Heerbrugg in 1947 and headed the Microscopy Department from 1949 until 1956. From 1955 onwards, he made films on natural-science topics, released records (including bird calls) and became famous to a wide audience for his natural-history programmes for Swiss radio and television.

It spoke for the vision of management, but also for the attractiveness of the company, that it succeeded in attracting top-class specialists to the Rhine Valley. In February 1946, Ludwig Bertele, as the specialist for the design of photo lenses at Zeiss-Ikon in Dresden probably the most important optics designer of his time, joined Heerbrugg as Head of Optics Development. He was entrusted with the development of a new type of high-performance lens for aerial photography. From 1959 under his leadership, the optical design office for the first time used an electrical calculation device for the design and optimisation of lenses, the Zuse Z22 – one of the first "computers" to be produced in series. WILD was the first Swiss industrial company to purchase such a system. With this electronic calcu-

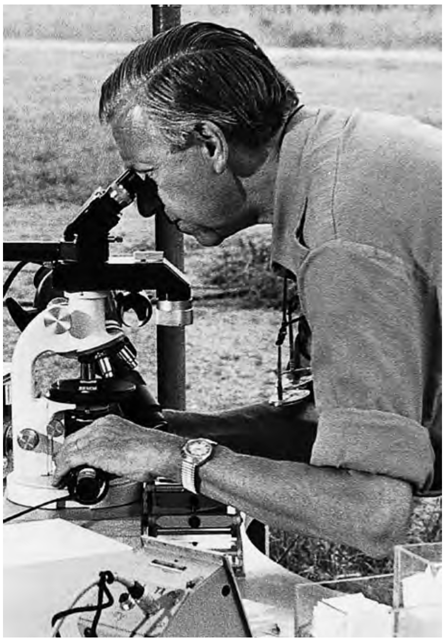


Fig. 7: Hans A. Traber at a M11 research microscope with an attached macrotube.

Fig. 8: To measure a distance between 100 m and 50 km, a DI50 was set up at each end-point and the distance calculated by measuring the transit time of the microwave radiation. The picture shows a DI50 being used in Mexico.

lator, it was possible to calculate about 3,000 refractive or reflective surfaces per day. Using traditional mechanical calculators, the same task would have taken two experienced employees 20 working days to complete.

On the night of 21 July 1969, people all over the world sat with bated breath in front of their televisions as the first humans, astronauts Neil Armstrong and Buzz Aldrin, set foot on the moon during the Apollo 11 mission. NASA made use of various instruments from Heerbrugg in its lunar landing programme. The T3 was used in the orientation of the Inertial Guidance System and the T2 for the optical alignment of the LEM lunar module during construction. During the television broadcast of the spectacular moon flight, an astronaut was seen on the screen carrying out positional measurements. WILD had supplied the lens system of the instrument used (called Space Sextant).

The age of electronics begins – with a cooperation

In 1958, an electronics department was set up in Heerbrugg. At the 10th congress of the «Fédération Internationale des Géomètres" (FIG) 1962 in Vienna the first microwave distance meter Distomat DI50 was presented. It was the world's first electronic distance meter with a measuring range of 100 m to 50 km and was developed in cooperation with the electronics company Albiswerk Zurich. This pattern can be observed time and again: radically new technologies were often brought into the company via appropriate cooperations or acquisitions. In 1963, a Distomat DI50 cost around 40 times the monthly salary of a surveyor – radically new technologies are often initially extremely expensive and therefore only useful and economical for very special applications.

The new premier discipline – optoelectronics

The first infrared distance meter, the DISTOMAT DI10, was a joint development with the French company Sercel (Société d'Etudes, Recherches et Constructions Electroniques) in Nantes, and was launched in 1968. It revolutionised surveying technology as the first close-range distance meter. It did not yet use a laser, but instead the infrared radiation of a

Fig. 9: The DISTOMAT DI10 on a T2 theodolite together with the control unit.

gallium arsenide diode. It marked the beginning of optoelectronics, which was destined to become a central technological core-competency in Heerbrugg.

At the 14th International FIG Congress in Washington in 1973, there was a great deal of interest in the new DI3 infrared distance meter. It became a geodesy best-seller, and the name DISTOMAT became synonymous with distance meters.

A Volkswagen from Heerbrugg

In the 1970s, analogue photogrammetry reached its peak. By 1975, 1,000 A8 Autographs had left the Heerbrugg factory. The A8 was often referred to as the "Volkswagen of photogrammetry". But technological developments, and digitalisation in particular, ultimately brought the autograph business to a standstill. Image processing and computer science became the new premier disciplines for the digital photogrammetry that followed.

Innovation requires technical excellence in new disciplines

While the first four decades were dominated by precision mechanics and optics, other technical and scientific disciplines such as electronics, computer science, photonics, physics, and mathematics became decisive for further development.

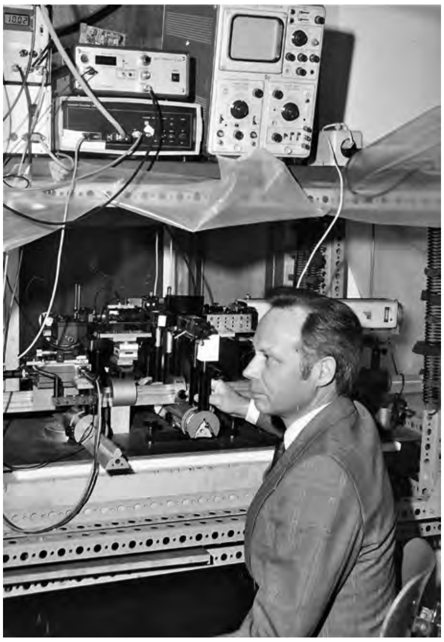


Fig. 11: Prof. Dr. Hans Tiziani from the University of Stuttgart started his professional career with an apprenticeship as an optician at WILD. He always remained loyal to "his" company and contributed to its further development in many areas.

It was recognized early on that an intensive exchange with universities was an essential motor for innovation. Dr Hugo Kasper, previously Professor of Geodesy at the Technical University in Brno, joined WILD in 1948 and took over the newly formed Research and Development Department for Photogrammetry. The A7 and A8 autographs, and the B8 Aviograph were developed under his leadership. In 1961 he was appointed Professor of Geodesy, especially photogrammetry, at the ETH Zurich. He remained in contact with WILD until his retirement in 1973.

In 1955, Hans Tiziani completed his apprenticeship in optics and mechanics at WILD. After training as a technician and qualifying as a mechanical engineer, he studied optics at the Sorbonne and the Paris School of Optics. He graduated as an engineer in 1963 and received his doctorate from Imperial College in London in 1967. From 1968 to 1973 he was responsible for establishing and managing the Optics Group in the Department of Technical Physics at the ETH in Zurich. From 1973 to 1978, he was head of WILD's central laboratory. In 1978 he was appointed to the University of Stuttgart and led the Institute of Technical Optics until his retirement in 2002. To this day, he remains in intensive contact with "his" company in Heerbrugg.

Max Kreis, a graduate in mechanical engineering from the ETH, joined the Heerbrugg design office in 1932. Throughout his professional career, he was a strong advocate of higher education. As President of the Executive Board, in 1968 he was a founding member of the Institute of Technology in Buchs (NTB), which today is part of the Eastern Switzerland University of Applied Sciences. For his part, Dr. Albert Semadeni, later President of the Board, brought about the construction of a cantonal school in Heerbrugg by tabling a motion when he was a member of the St. Gallen Cantonal Council. The school opened in 1975.

The exchange of personnel and ideas with universities was and is an important ingredient in the recipe for innovation. In particular, Prof. Fritz Brunner and Prof. Werner Lienhart from the University of Graz, Prof. Roman Boutellier and Prof. Hilmar Ingensand from the ETH Zurich, Prof. Reinhard Gottwald and Prof. David Grimm from the FHNW in Muttenz, all of whom

Fig. 10: A8 Autographs with plotting tables in operation.

gained professional experience at WILD and Leica, respectively, should be mentioned here. Even the current FIG President Prof. Rudolf Staiger has his professional roots here.

Surveying 4.0 begins in 1977

The fully automatic electronic infrared tachymeter TC1 was presented at the 15th international FIG Congress in Stockholm in 1977. The electronics took over the measurement of the distance and the angles as well as the logging of the measured values. A cassette recorder was used for data storage. This marked the beginning of the era of computer science in surveying.
At the beginning, however, digitalisation was a bulky and weighty affair. For the first time ever, in 1980 the GEOMAP system enabled continuous data flow from geodetic field measurement to the finished graphical plan using the interactive graphical workplace-computer Tektronix 4054.

Fig. 12: The Wild TC1 was a fully automatic tachymeter with a cassette recorder for digital data storage.

Fig. 13: The GEOMAP system. The screen was used to display the graphics. Top left a TC1 and to the right the plotting table are shown.

WILD receives signals from space

In December 1984, the WM Satellite Survey Company was established as a joint venture with the Magnavox Government and Industrial Electronics Company in Torrance, California. The new GPS surveying system WM101 was presented as early as May the following year. This was the beginning of the GNSS success story that continues to this day.

Fig. 14: The WM101 GPS surveying system "is an easily transportable piece of equipment weighing only 14.5 kilograms" – an extract from the advertising in 1984. Here shown on a 1991 Greenland expedition.

Wild Heerbrugg – Wild-Leitz – Leica – Leica Geosystems

The years from 1988 to 2000 were eventful years in terms of company names, composition and ownership. The acquisition of Kern in Aarau, which was extensively discussed during its 200th anniversary celebration in 2019, brought a bundled load of industrial-measurement technology to Heerbrugg, and this today still represents an important market segment within the Hexagon Group.

Crazy ideas sometimes become successful products

In 1990, at the most important surveying congress in the USA in Denver, the NA2000 attracted a great deal of attention as the world's first digital level. It carried off the innovation prize in photonics. The instrument reads the barcode on the staff and compares it with the signal mapped onto a line sensor. The associated algorithm is the real magic of the device. It was a major challenge for the discipline of the industrial mathematicians, who had to succeed in optimising an evaluation algorithm which worked on a PC in such a way that it also delivered good results on a field device in an acceptable time.
The idea of launching a more accurate alternative to the ultrasonic devices and steel measuring tapes available on the market, based on all the experience with the high-quality add-on distance meters,

Fig. 15: The original DISTO of 1993 – still weighing 900 g and rather expensive.

was greeted internally with a tired smile. In the end, however, the DISTO, the world's first hand-held laser distance meter, set new standards. When it was presented in 1993 at the international construction fair BATIMAT in Paris, this new development created a real stir and was awarded a prize for innovation.

Everything is digital – workflow and stock-market launch

Developed jointly with the Institute for Optical Sensor Systems of the DLR (German Aerospace Center), the first digital aerial camera, the ADS40, was presented in 2000. The success of the sensor was also largely decided by a robust workflow, which required effective, frictionless processing of the massive amounts of data generated during flight operations. Software innovation was the key to this.
With the acquisition of the Californian company Cyra Technologies, in 2000 Leica Geosystems was the first surveying company to invest in the future technology of laser scanning. This technology was quickly internalized and developed further in Heerbrugg. Under the slogan "High Definition Surveying", the next-generation laser scanner HDS3000 was presented alongside the new Cyclone 5.0 software. In 2006, not only the development but also the production of the scanners was concentrated in Heerbrugg.

Stronger together – Sensor Fusion

In addition to the company's own innovation activities, acquisitions played an increasingly important role in the continuing development of the range of solutions on offer. This trend was further accelerated by the acquisition of Leica Geosystems by the Swedish technology group Hexagon AB in 2005.
In the past ten years, the acquisition of nearly 40 companies has both strengthened the company's presence in emerging markets, and with their wide range of technological and industrial competence these companies have supported its expansion into new target markets.
In 2013, for example, the acquisition of Italy's Geosoft laid the foundation for the Pegasus mobile mapping product line, which records image and LiDAR data in a GIS-enabled platform while in motion, thus enabling complete capture of the surrounding area. The acquisition in 2015 of the Berlin company Technet added GIS software solutions for railway applications to the Pegasus product line. In addition, with the acquisition of the Italian company IDS GeoRadar in 2016, extremely competitive radar solutions were obtained, such as ground penetrating radar systems, with which non-visible underground pipes and cavities can be precisely detected. In combination with Pegasus, recorded underground infrastructure can be directly linked to the spatial data recorded above ground.
CityMapper, the world's first "fused sensor" for aerial photography, with completely newly developed cameras and laser sensors, was introduced in 2016. It consisted of an RCD30 multispectral camera in the centre, four oblique RCD30 cameras angled at 45°, and a Hyperion LiDAR unit. It had been specially designed for challenging 3D city views and formed part of the RealCity overall solution for the creation of 3D city models.
In 2017, the first GNSS with true tilt compensation was introduced. The GS18 T was the world's fastest and easiest-to-use GNSS RTK rover. From then on, any point could be measured more quickly and more easily, as the pole no longer had to be held vertically. The development of a robust tilt compensator had been an R&D target for decades. The solution was an IMU (Inertial Measurement Unit) integrated into the GNSS antenna. This recorded acceleration and rotation values and offset them against the GNSS position data.

Fig. 16: On the occasion of Leica Geosystems' stock-market launch in 2000, the Zurich stock exchange was also transformed into a point cloud using a Cyrax 2500.

Just as Heinrich Wild would have wanted – smaller, lighter, simpler and mobile

On 18 November 2016, CTO Burkhard Boeckem presented the BLK360 to the public at the Autodesk University 2016. Just as Heinrich Wild would have wanted, this timelessly elegant laser scanner with its compact design and a weight of only 1.1 kg was the smallest, lightest, and most powerful device on the market. The BLK360 won countless design and innovation awards. In addition to surveying-related applications, it is also increasingly being used in less conventional areas such as forensics, the film industry and archaeology, thus considerably expanding its market. A dedicated team brought this product to market in a surprisingly short time using the latest development methods. Even 100 years after the company was founded, the spirit of Heinrich Wild still wafts through Heerbrugg: "smaller, lighter and simpler is what the new product has to be" – with the T2, Heinrich Wild had shown the way! The first hand-held imaging laser scanner BLK2GO was presented at HxGN LIVE 2019. In real-time, as the user moves, it digitises rooms in 3D using images and point clouds. The integrated SLAM technology (Simultaneous Localisation and Mapping) enables the precise determination of the movement path whilst simultaneously capturing the geometry of the space. And once again the spirit of Heinrich Wild beckons – "small, light and mobile" like the T2.

Fig. 17: The BLK2GO hand-held laser-imaging scanner digitises space in 3D while you move.

100 years and still raring to go

Leica Geosystems focuses on the five areas of surveying, construction, heavy-machine control, mining and geospatial solutions and will continue to write the book of innovation in these areas. An anniversary exhibition in Heerbrugg shows the past, present and future in five thematic islands: Urban Development, Building, Infrastructure, Safety and Manufacturing.

But innovation does not just come on its own. First of all, it costs a lot of money. Hexagon invests between ten and twelve percent of its turnover into research and development each year. And successful innovation also mandates the necessary corporate culture. Since the company was founded in 1921, it has always remained important to mix the good local conditions with new ideas brought in from outside. The fact that the approximately 1,000 employees in Heerbrugg today comprise over 45 nationalities is one more important ingredient which enables and promotes this innovation culture.

Heerbrugg will continue to write exciting innovation stories!

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