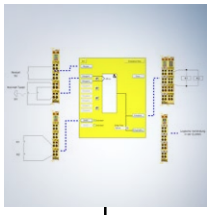
# PC-based control and TwinCAT achieve numerous milestones in automation technology history

The milestones of TwinCAT development

**S2000**
Software PLC/NC/CNC on PC (DOS)

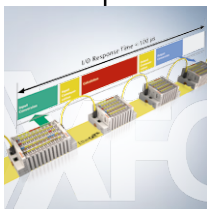


**TwinSAFE**


1988 1993 1996 2005 2008 2010

**S1000**
Software PLC/NC on PC (DOS)


**TwinCAT**
real-time software package under Windows with PLC and Motion Control functions



**XFC**
eXtreme Fast Control Technology

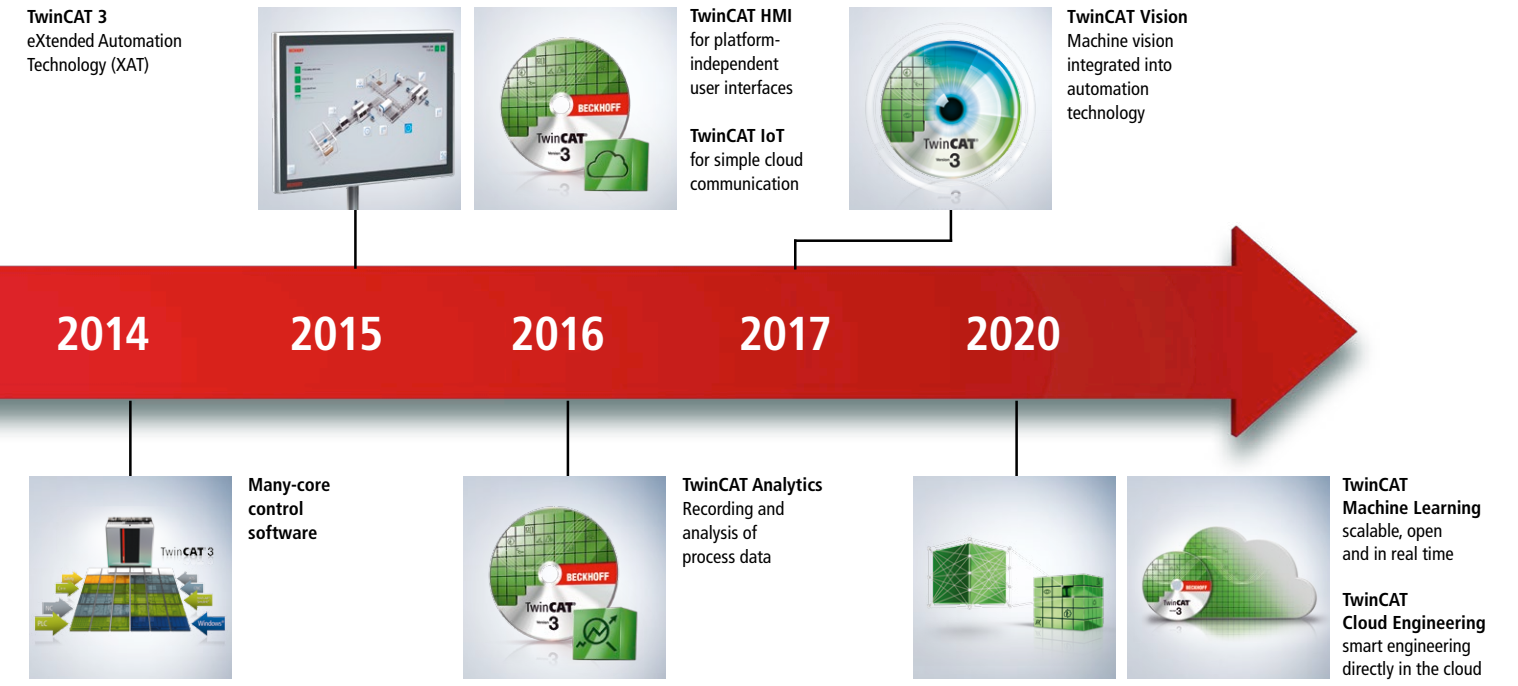
In the years following 1986, Beckhoff introduced the S1000 and S2000 PC-based control systems to the market. From 1990 onwards, Beckhoff developed the hardware platforms themselves and used the company's own all-in-one motherboard for the C2000 Industrial PCs. TwinCAT – The Windows Control and Automation Technology – was introduced in 1996. In a new approach, Beckhoff adopted the Windows operating system after DOS and added a complete engineering environment in one software solution. The configuration was carried out in the TwinCAT System Manager and the software could be programmed according to IEC 61131-3 as established by PLCopen. Motion control functions could be implemented from simple traversing axes to coupled axes to CNC. Openness with regard to different fieldbuses was also a must, consistently configured and diagnosed in the TwinCAT System Manager.

In addition to classic Industrial PCs, Beckhoff also developed DIN rail-mountable control devices. The CX1000 Embedded PC was the first to be equipped with both the Windows operating system in the respective embedded version as well as the very compact Windows CE operating system, with TwinCAT Runtime available for both operating systems. Safety technology was the next big component in the PC-based control toolkit. In 2005, Beckhoff introduced TwinSAFE with both new "yellow" terminals and safety-related engineering in the TwinCAT System Manager. A simple graphical configuration instead of programming was sufficient to create machine safety projects. A new generation of motherboards – called CBxxxx – was presented in 2007. Available in various packages, this motherboard was very successful in the market. With new Industrial PCs, EtherCAT, I/O terminals with special functions and, of course, TwinCAT, it was possible in 2008 to achieve a response time of less than 100 µs and thus significantly improve processes.

**Performance boost with the new TwinCAT generation**

A new era began for TwinCAT in 2010 with the introduction of TwinCAT 3. An essential feature was the integration into Microsoft Visual Studio® which meant further convergence of IT and automation technology in the Beckhoff ecosystem. As a result, the same methods and toolboxes can be used in IT and automation technology. IT relies on C++, which automation engineers can now also use in TwinCAT; the automation technology is well equipped in the third edition of IEC 61131-3 with object-oriented features for PLC languages. The integration of MATLAB®/Simulink® – known from the academic world – complements the range of possible programming languages. With TwinCAT 3, the TwinCAT runtime is available for 64-bit operating systems, and the multi-core properties of the processors are optimally used. As an example, TwinCAT 3 and the C6670 Industrial Server presented in 2014 with up to 40 cores, enables the parallel execution of particularly computationally intensive tasks, such as measurement technology, image processing, XTS and XPlanar.

Hans Beckhoff founded Beckhoff Industrie Elektronik in 1980. The first projects were control systems based on a Motorola microprocessor for machines in the wood and window frame construction industry. The term "personal computer (PC)", became increasingly and exclusively associated with the IBM PC and its IBM-compatible PC-replicas from 1981 onwards. Variants of the x86 processor family were installed and the DOS operating system was used. In 1986, Beckhoff modified the hardware and operating system in such a way that motion control could also be implemented with it – a long and, above all, innovative and successful path to today's modular TwinCAT 3 software generation.

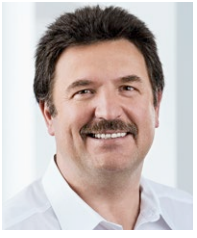



Industrie 4.0 was the dominant topic in the following years. Numerous TwinCAT IoT products became available, especially for provider-independent connectivity to the cloud. The technology behind TwinCAT HMI – introduced in 2015 – was once again looking to IT. The technology behind the standard web browser has been and will continue to be oriented towards HTML and CSS. Why not implement this successful technology in automation as well? The advantages include numerous available toolboxes and the possibility to display the visualization with any browser, completely independent of the operating system. With the ability to send data to the cloud using IoT protocols, the need to analyze this data emerged. As a result, TwinCAT Analytics emerged in the automation environment in 2016. In 2017, Beckhoff introduced TwinCAT Vision with numerous advantages over existing machine vision solutions: complete integration into the engineering toolboxes, programming in PLC languages, and the embedding of algorithms in real time, which eliminates unnecessary latencies. This means that image processing can be operated synchronously with motion control.

In 2019 Beckhoff introduced a new operating system with the CX7000 small controller. TwinCAT/RTOS represented a very lean solution for the smallest controllers. At the same time, Beckhoff created an OS for medium to large processors with TwinCAT/BSD. Neither of the operating systems are intended to replace Windows – they complement it.

The year 2020 was marked by the introduction of TwinCAT Cloud Engineering and TwinCAT Machine Learning. TwinCAT Cloud Engineering moves the TwinCAT tools to the cloud. In the future, TwinCAT Machine Learning will ensure much higher efficiency in the area of motion control, it will be used to create virtual sensors and it will be used to analyze large data volumes.

**Left: Andreas Thome, Senior Product Manager, PC-Control**
**Right: Dr. Josef Papenfort, Product Manager, TwinCAT**



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