

Large photo: With the aid of Mechatronic Support from Siemens, the SpeedLine C100 automatic production lathe was brought to series production more quickly than ever before

Small photo: From simulation to reality to a virtual machine: Index uses all the digital means at its disposal to optimize both internal and external efficiency

■ **Index-Werke, Germany**

Kinematics “Virtually” Secured

Mechatronic Support from Siemens validates new kinematics concept for innovative automatic production lathes.

Esslingen-based Index-Werke worked closely with Siemens, in particular, with Mechatronic Support in Erlangen, to achieve validation of the innovative machine and kinematics concept for a new family of highly productive and accurate automatic bar lathes at a very early stage of development, using simulation. As a result, the machines have been brought to series production more quickly than ever before and with greater reliability. The SpeedLine automatic production lathe series, which is equipped as standard with Siemens drive and control technology, will be making its debut at EMO 2007.

New productivity for bar turning

What's really impressive about these innovative automatic lathes is the unique SingleSlide concept – a special guide system featuring two degrees of freedom on one level thanks to parallel kinematics. This new approach significantly improves guidance, damping, dynamics and rigidity compared with conventional designs, which results in enhanced workpiece quality, substantially increased tool lifecycle, greater acceler-

ation (1 g in all axes) and quick movement (60 m/min); this ultimately leads to superior processing performance. The SpeedLine C100 has a main spindle and a counter spindle (bar capacity 30 mm or 42 mm) as well as three turrets, each of which has 14 stations. These turrets are extremely fast and flexible and can be used – separately or simultaneously – for the complete machining of complex workpieces. Initial feedback suggests that, in practice, this leads to significantly higher productivity than that achieved using comparable predecessor models.

Mechatronic Support involved from the start

It stands to reason that any mechanical engineering company wants to establish as early as possible whether a completely new approach actually works in practice – or rather, whether it will work in the future. For this reason, Index got Siemens Mechatronic Support on board right from the development phase; the Esslingen-based company had already used the service to good effect in the past to optimize an existing machine. Among other services, the mechatronics ►►



The Sinumerik 840D powerline is the established standard at Index – and it's now available with a three-channel editor for efficient and reliable operation

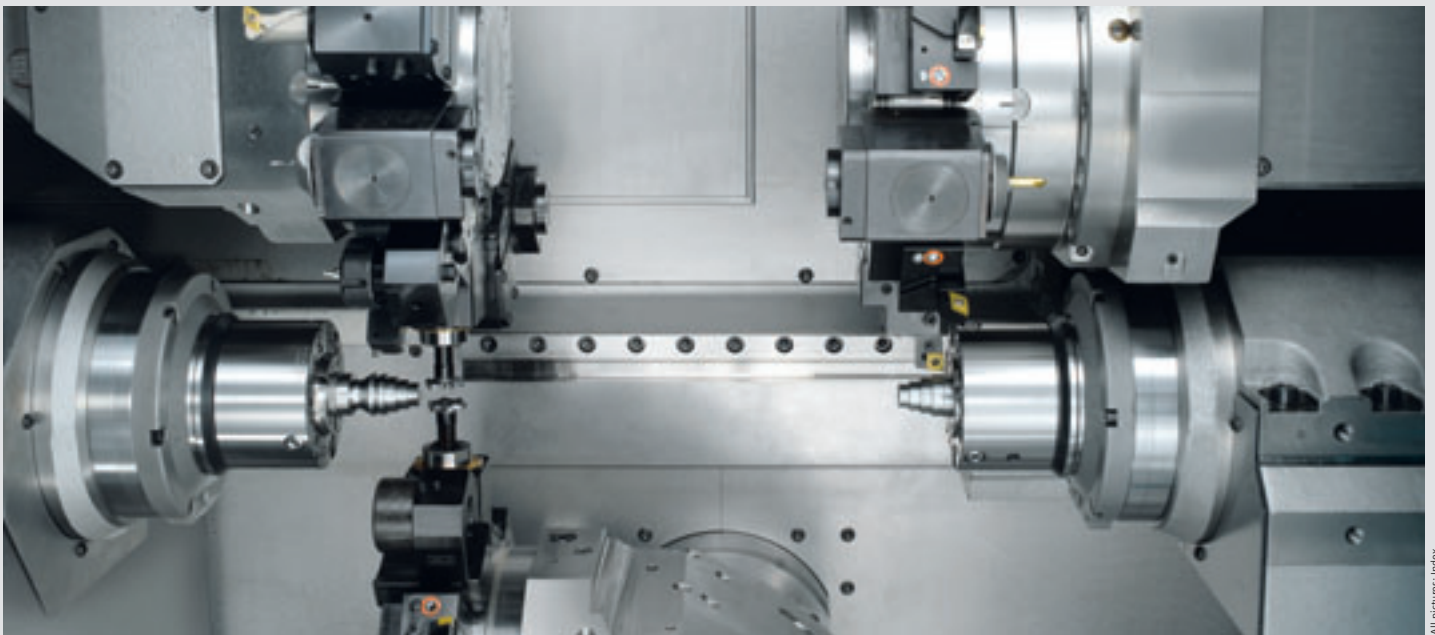
►► specialists used the CAD data from a statistical FEM analysis carried out by Index to generate a digital model of the future machine. They then mapped relevant data relating to the designated motors, ball bearing screws and drive control systems to this model. The aim was to use this complex model to simulate the behavior of the machine from machining, in particular the dynamics, rigidity and precision of the driving axles under all conceivable loads and when subject to the most diverse range of disturbances on the control systems. The new machine kinematics were thoroughly examined for any weaknesses (such as “crosstalk” between the parallel kinematics/axis assembly), allowing feasibility to be assured at an early stage without the need to build even a single prototype that would subsequently have required various optimization cycles, which are usually time and cost-intensive. One specific result of the simulation was the expected servo gain (Kv) factors, which were verified in practice at all driving axles on the actual machine.

(Cost-) optimized switch cabinet construction

The switch cabinet concept for the new machine series has also undergone various rounds of technical and financial optimization. The cabinets produced by the Siemens Solution Factory for Automation and Drives, Chemnitz (WKC) are fully equipped with Siemens components and are delivered to the assembly location in Esslingen, as required. Using a vertical machine base makes it possible to install a lot of the components directly in the frame structure above the working area, allowing the shortest possible cabling route from above without kinking or crushing. This facilitates a level of accessibility that has never before been possible, making the SpeedLine series easy to maintain.

Multi-channel machining made easy

The simultaneous machining operations at the main and counter spindles using all three tool turrets are controlled using a three-channel Sinumerik 840D



All pictures: Index

Above: The SpeedLine C100 has a main spindle and a counter spindle as well as three turrets, each of which has 14 stations

Below: Workpieces machined on the SpeedLine C100



powerline. Siemens has implemented the functionalities of the new kinematics using compile cycles in the open NC kernel of the control system. This means that machining programs can easily be created for these functionalities using workpiece Cartesian coordinates. In addition, for the first time (and especially for Index), a three-channel step editor was created that makes it possible to show the programs of the three subsystems in an image as well as processing, checking and optimizing them – simultaneously or in sync. This is available as an option with the “Virtual Machine” for the SpeedLine series. The heart of this PC-based, full-scale “copy” of the control, operation systems and the machine is the virtual NC kernel (VNCK) of the Sinumerik 840D.

Simultaneous motor optimization

As part of this development project, the company also used prototypes from the new Siemens 1FT7 motor generation and helped to optimize these. As a result,

the motors now fulfill the tough dynamics and precision requirements imposed by Index almost without exception. Eberhard Beck, Head of Control Technology and authorized signatory at Index, sums things up: “If anything is worthy of the tag “simultaneous engineering”, it’s the truly close cooperation that went into the development of this new machine series, which has led to a real win-win situation for both Index and Siemens.” The experience gained was transferred almost as-is to the identically constructed SpeedLine C200, which is designed to process bars with a diameter of 65 mm or 90 mm. This also means that the machine was developed in a very short period of time. ■

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