

Monolithic Reliability

HELMUT DAMM



According to the motto "too many cooks spoil the broth", one of the leading machine tool manufacturers of the world, the Okuma Corporation in Oguchi, Japan, unalteredly sticks to its >Single-Source-Supply< strategy. For the sake of a smooth functionality of the machines, the company produces and assembles also control units, drives and measuring systems - next to the mechanical bodywork - exclusively by themselves. The >Jimtof< fair by the end of last year in Tokyo more then proved among others that this company succeeds in not lagging behind the competition come to technology innovation matters.

■ With its more than 105 year old company history, Okuma counts among the foundation members of the Japanese machine tool industry which developed very hesitantly in the shadow of the first branches of heavy industry around the turn of the century. It was not but after World War II with the upcoming automobile industry that the Japanese machine tool manufacturers experienced a strong demand for flexibly usable machine tools. While the Japanese machines were rather known for their inferior quality until then, they were

considered the archetype for high quality, simple application and reasonable pricing worldwide since the seventies [1]. Initially, a large part of the manufacturers focussed on the simplification and improvement of external products in the form of >reverse engineering<; Okuma, however, came up with their own control unit >OSP< as early as in 1963. The path treaded at that time has unalteredly been kept up until today: Okuma offers its customers machines from a single source, which was called >Single-Source-Supply<, from head to tow so to speak: machine construction, control unit, drives and measuring technology are all in-house developed, produced and assembled by Okuma (fig. 1).

Mother of all machines reproducing itself

With a production output of up to 4,500 machines per year, Okuma disposes of enormous capacities at two production locations. Large-size and high-precision parts are exclusively manufactured in-house at the Kani location on an area of 23,000 sqm where fully automated and linked machining cells are available, among which Okuma's own machines are to be found to a large extent (figs. 2 and 3). The experiences gained in this way directly flew back into development. Medium-sized and above all smaller parts are outsourced to external suppliers - a solution which cannot be avoided with approx. 1,400 employees in view of the enormous machining depth. At the Nagoya location, the assembly and commissioning divisions are settled next to the company group

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1 Drive technology as core competence: Okuma manufactures the drives for the machine tools in their own clean rooms - which grants high quality and ensures a fast reaction to changes and modifications

headquarters and the development division on an area of approx. 15,000 sqm.

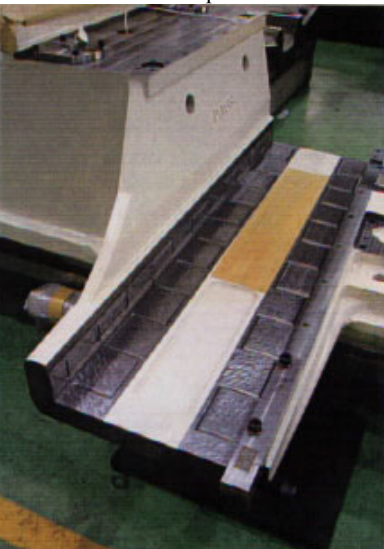
The slump in demand last year has not failed to leave its mark on Okuma as well. In accordance with the National Machine Tool Federation, in particular the Japanese manufacturers lived through a very selective year: the consumption in machine tools dropped by 56 percent in Japan whereupon the total production had to be reduced by 30 percent. It is no wonder that exports gain a higher and higher significance. However, the most important market for Okuma is no longer North America, as was still the case in the year 2000 with an export share of 48 percent. Europe and the Pacific area advanced to ranks 1 and 2 with shares of 48 and 27 percent last year.

Aspects supporting the successful marketing of the machine pallet abroad are the proven high quality, solidity and thus high availability of the massive machines (fig. 4). These properties result from the above mentioned single source policy and the consistent development ▶▶▶



2 Linked FMS: the >MC-600-H< machining centers in the background are supplied via setup stations for clamping the workpieces in the foreground plus an extensive high-rack storage area (on the right)

▶▶▶ work put into the most important machine components: in drive technology, Okuma disposes of brushless servo motors for the machine axes, with a torque between 2.4 and 70 Nm, up to 3,000 rpm and 0.75 to 7.5 kW output. As spindle drives, asynchronous motors with an output between 2.2 and 55 kW may be selected, flanged or designed as direct drives. For the parallel-kinematics

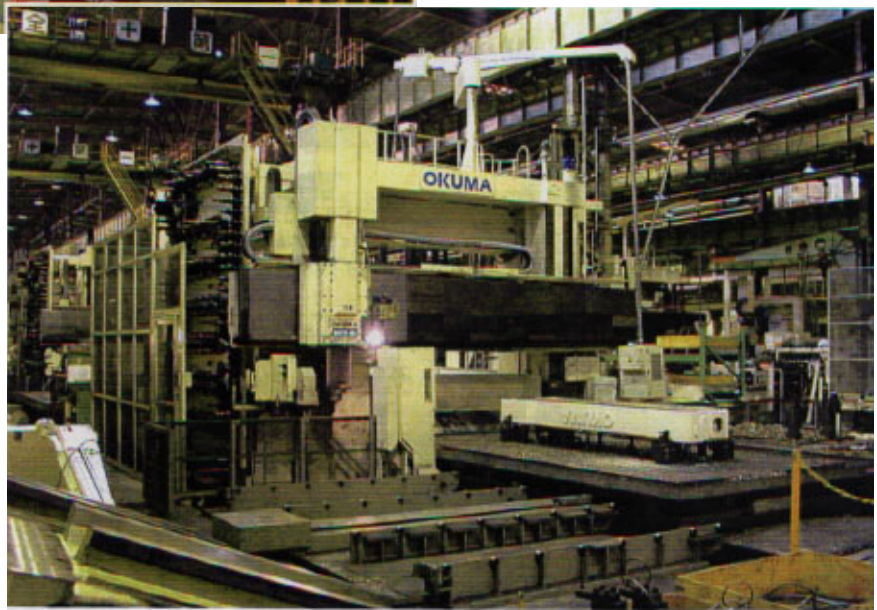


4 Massive machine body and manually scraped guideways: these are quality features to which the traditional company sticks unalteredly

Trend towards PC controls and extensive software

As to the OSP control units, Okuma presently offers four variants from two series: the >U< series with useful PLC functions has been available to European users as >U10< for standard machines and as >U100< for high speed applications since 1999. Since the end of 2002, the machines may also be ordered with the E series. As 10 or 100 version, this further development is equipped with Windows surface, 10 Mbit/sec Ethernet interface, servo and encoder link and numerous software modules. The PC oriented P-control is still under work.

Under the motto >IT on MT<, a large software package for the OSP control units was presented on the Jimtof. Next to full-fledged 3D-CAD-CAM and simulation systems, the



3 It reproduces itself: Okuma machines are machined on Okuma machines wherever possible

machine >Cosmo-Center PM-600< (fig. 5), brushless hollow-shaft servo motors were developed. This machine conception attracted considerable attention at the >Jimtof< fair last year considering its 1.5 g axis acceleration, a rapid feedrate of 100 m/min, and a machine accuracy of 1 μ m. Another Okuma invention are the >Prex< synchronous motors presenting a compact and low-cost drive solution both for indexing the turret and for driven tools on lathes with an output of between 0.6 and 2.8 kW. All of the drives and encoders are assembled and tested in a clean room. Furthermore, Okuma is working on even faster linear motors for large multi-axis machining centers with feedrates of up to 50 m/min - at present, 30 m/min can be realized. Another focus of development are HSC compatible, linear absolute measuring systems. The Okuma solutions offer a resolution of 0.1 μ m and handle feedrates of up to 150 m/min. A laser measuring system even achieves a resolution of 0.01 μ m.

>MacMan< is also offered - a complete machine data acquisition system which can be networked with each server for order tracking as well as status inquiry and monitoring also via external terminals. The software module >Admac Parts< allows for directly deriving and generating NC programs, part drawings, tool lists and work flow diagrams from the digital part data.

Also the Okuma machine program presented on the Jimtof revealed numerous innovations. Among others:

- vertical machining center >MB-46-C-SS< for the HSC machining (60,000 rpm) of high-precision parts and mirror-finish surfaces,
- horizontal machining center >MA-400HA< for the high-speed machining (feedrate 60 m/min) of automobile parts,

- vertical 5-axis universal machining center >MU-400VA< with 400 mm rotary table for the precision-machining of bucket wheels,
- horizontal HSC machining center >Flex Center 40H< with part feeder for the series production of aluminium castings,
- multi-function turning center >Mac-Turn350-W< with nine controlled axes and opposed spindle for the complete six-face part machining and production in small lots,
- compact cylindrical grinding machine >GA-5N-SP< for the high-precision machining (0,01 µm) in very restricted space.

In the production halls in Nagoya, a further trend was to be noticed: with modern and state-of-the-art optics, the manufacturer now intends to satisfy those potential users who up to now thought the machine design to be too conservative (fig. 6).

Finally, Okuma intends to increasingly present themselves also as solution provider for the mold and die production. Concerning the subject of the latest machines for vertical and horizontal machining in the Technologiezentrum in Langenau, we spoke with the business manager of

Okuma Europe, Mr. Karl-Heinz Dreyer:

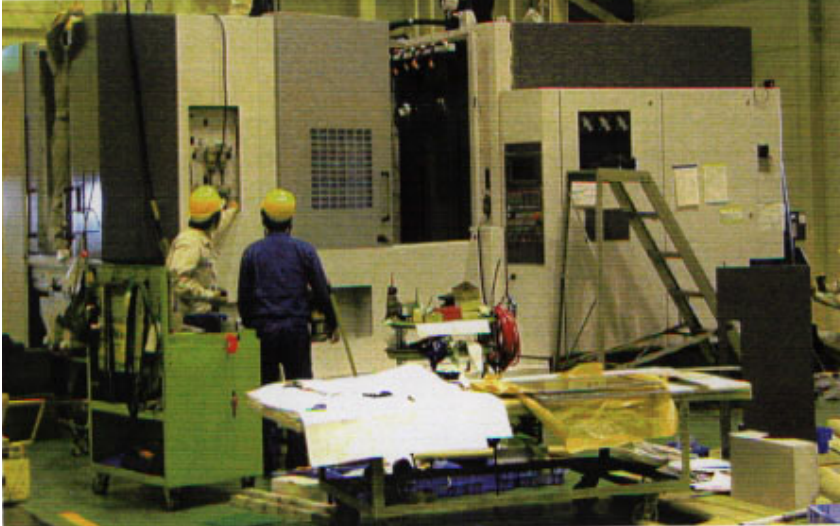
WB: Mr. Dreyer, what do people at Okuma think to be particular requirements on mold and die production and how do you react to such requirements?

Mr. Dreyer: The requirements in mold and die production largely meet the product philosophy of Okuma: a rigid machine structure and dynamically rigid drives play a key role in this connection. Long program-controlled operating times demand for thermally stable machines for the face machined in the morning to seamlessly turn into a pocket at noon. This is granted by Okuma using a matured, rigid construction as basis, highly dynamic drives and state-of-the-art compensation strategies. Especially the newly developed compensation of external disturbance variables allow for reducing their effect on the machining result by two thirds. In this way, we were able to partially cut the machining time in half due to a revised Super Mainboard and a new Super-Nurbs strategy.



5 Parallel kinematics Cosmo Center under construction: from the few manufacturers of these machine conceptions, Okuma is the only one to already serve several users in the automobile environment

COMPANY PROFILE



6 Eye-catcher: despite the new design, the manufacturer abides by well-tried and well-established values concerning the design and construction of machining centers

WB: Will Okuma be able to keep up with the products of the specialists for drives, control units and measuring technology with their in-house developed components or even take over technological leadership in the long term?

Mr. Dreyer: The past has shown that this is possible. Okuma's strength lies in the continued further development of the control unit and drives in the interest and to the advantage of our users. Only the deep knowledge of the last bit and the last resistance allows for the optimum utilization of the potentials. An ambitious thing which is hard to realize across the borders of companies and interest groups. Whereas others philosophize about >servos< or >step<, we have already proceeded to the next step: linear scales with a resolution of 0.01 µm, sampling rates of 0.1 msec for the drives: this is what the customer receives from us already today and what he will put to use to increase his productivity tomorrow. This is technological leadership.

WB: How do the experiences of European users flow into the development in far-away Japan?

Mr. Dreyer: Fact is that the European market requirements have already and increasingly been giving direction to the development of the new model series in the Okuma central headquarters in Japan since the end of the nineties. After having come to the conclusion that in Central Europe the requirement profiles of the consumers are the largest due to the high competitive pressure and the different social structures, and that similar

problems will also arise in other focal markets, our experiences are the set targets. This fact has fully flown into the current model offensive of a new machine generation which is currently being introduced to the market step by step, with special focus on the EMO in Milano.

WB: Which competitive advantages does Okuma offer against the strong domestic competition on the hard-fought German cutting market?

Mr. Dreyer: The name Okuma stands for very high availability, profitability and productivity, reliability as well as long-term accuracy. This is guaranteed first by the fact that all mechanical and electronic components, including control unit and software, come from Okuma. This guarantees an absolute product homogeneity. Interface adaptations and competence discussions are irrelevant to us. All components for a new machine series are perfectly harmonized right from the first steps during the development via the construction up to the production. Second, a very solid mechanical machine design and construction based on 100 years of machine building experience and optimized by appropriate electronic elements. It is completely against our principles to optimize and safeguard >light-foot< mechanics by electronics.

WB: The Japanese economy fights deflation, the financial world is weak in the legs. How solid is the quoted Okuma company?

Mr. Dreyer: A safe indicator for the state and condition of a company are number and kind of future-oriented investments and measures. Here, Okuma may defer to a number of activities over the last two years despite the worldwide recessive economical climate: setup of two

technology centers in the United States, in Detroit and Los Angeles, takeover of the company organization in Australia with an independent Okuma Ltd. in Melbourne. A joint venture in China with the largest national machine manufacturer - Beijing No. 1 - with a complete new production site close to Beijing, in order to produce machines for the dynamic market starting from the second half 2003. Building of our technology center South Germany in Langenau close to Ulm the inauguration of which was in autumn 2002. Furthermore, a larger development offensive in the course of which we are going to present 20 new models within a period of twelve months. The presentation of these models for Europe will mainly take place in the second half of 2003.



Karl-Heinz Dreyer, business manager of the Okuma Europe GmbH with their headquarters in Krefeld

WB: What development has the European business of Okuma taken since the foundation of the European central headquarters in Krefeld in 1988?

Mr. Dreyer: As anticipated, the development has been positive through and through - apart from the recessive European phases. More than 22,000 machines have been installed in Europe so far with the emphasis lying on the past ten to twelve years.

LITERATUR

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