

Production Yamagata Casio Receives 2005 Nikkei "Monozukuri" Grand Prix

Yamagata Casio Co., Ltd., manufactures cellular phones, wristwatches such as the G-SHOCK series, and digital cameras, as well as metal molds and molded plastic components for the products. It also develops and sells chip mounters for electronic component mounting equipment.

The Mold Making & Molding Division, which makes metal molds and produces molded plastic components at Yamagata Casio, received Japan's 2005 Nikkei "Monozukuri" Grand Prix for a Digital Network System installed at its plastic molding and precise metal molds factory.

The reasons Yamagata Casio won the award are described below.

Cellular phone and digital camera products are subject to rapid replacement by new models. In order to meet the short and intensive production periods for these products and to integrate the process from metal mold creation to part molding, Yamagata Casio has incorporated IT into the entire production process. As a result, the lead time for metal mold production has been greatly reduced. This innovation was recognized for advancing *monozukuri* ("true craftsmanship") in Japanese production technologies.

- All 500 PCs and devices such as CAD/CAM systems and machine tools are connected to a network, and each person has a PC.
- Computer intensively manages ongoing conditions for each metal mold along with drawings, and all

personnel share the production schedule through PCs. No paper drawings are used anywhere in the mold factory.

- A mold diagnostic system was introduced in the molding process to prevent fatal flaws in the metal molds. This system measures ultrasound emitted by the mold during each molding operation, assessing the condition of the mold using a point system. If the result is below 40 points, the molding machine is shut down and the mold is repaired. This enables the impact of a flawed mold to be minimized in a production period that is short and intensive.

Thanks to this Digital Network System for a plastic molding and precise metal molds factory, Casio's cellular phones and wristwatches move from development, to production, to market in a very short period of time.

Japanese *monozukuri* manufacturing technologies are facing stiff competition from overseas today. Yamagata Casio is leading the way for other Japanese manufacturers with this system. This was another factor in the judges' decision to give the award to Yamagata Casio for implementing this system.

The Digital Network System for a Plastic Molding and Precise Metal Molds Factory

Here is an explanation of how the system actually works.

Metal mold design and data preparation

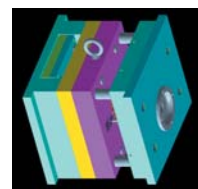
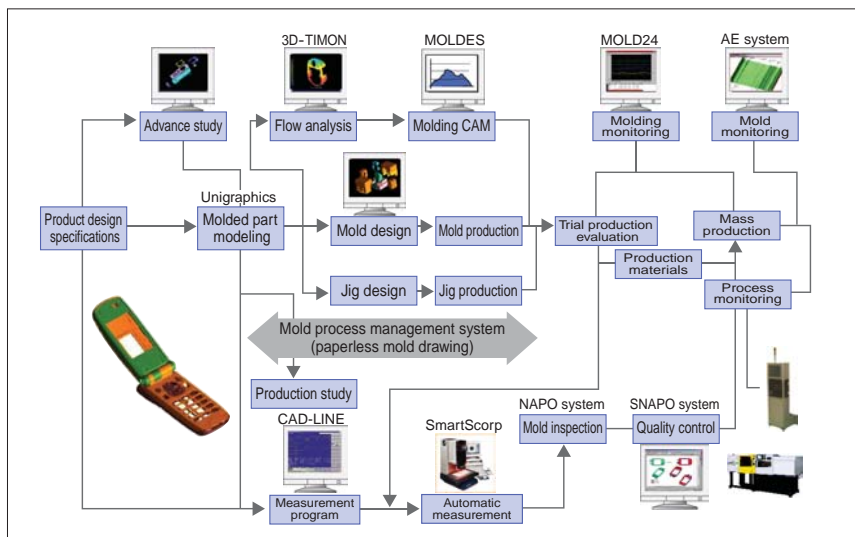
After receiving 3D digital data for a cellular phone or a timepiece from Casio Product Design Department, the data is used to design a metal mold for a plastic housing. Then the completed metal mold design data is used to create a computer simulation of actual resin flow inside the mold at the time of trial production with an injection molding machine. This way, any problems can be discovered in advance and resolved.

Metal mold production

Using the completed 3D design data, the mold manufacturing process begins using equipment such as a machining center and an electrical discharge machine. The 3D digital data is sent from CAD/CAM design tools to a machine tool connected via the network, and the tool automatically starts processing a mold; all the operator has to do is to confirm the operation using a computer. Through this process, a mold is completed with minimal errors or problems.

Also, tasks previously performed only by experts such as shaving and polishing in units of microns and other minute adjustments are all done through the digital network. There are computer screens in front of all the operators in charge of shaving and polishing, which display the mold parts in 3D. The parts are coded by several colors, and each color shows each operator's part in the processing. Through this system, it is now possible for a person with a basic level of experience to do the work of a skilled technician. The computer has enabled regular operators with a basic level of experience to do the work previously done only by experts looking at complicated drawings. This technician support system has greatly increased accuracy and improved the quality of mold processing once done by hand.

The Digital Network System for a plastic molding and precise metal molds factory



External view of metal mold



Piece inside metal mold

Trial molding

Even for trial molding with a mold already completed in this way, the initial 3D data plays an active role. The system determines the optimal molding conditions after making close reference to the database of metal molds & molding, together with the database of molding machine & resin, which have been built up over the past 15 years. The optimal conditions are sought in the shortest possible time by sending the initial 3D design data to the said system and running a simulation. The resulting data is then also compiled, which helps reduce development lead time, improve quality, and raise production yields in the future.

Mass production and monitoring

Using the conditions just determined, the mold moves on to the mass production stage. The factory contains about 40 injection molding machines, enabling a molded part to be produced every 10 seconds. All these machines are also connected to the network. Each time one part is finished, process-result data are sent to the computer server. The computer monitors all operations of each machine. If there are any irregularities, an alarm goes off, and if there is a possibility of a defective product, the machine is shut down. The system prevents defective products from coming off the line.

However, since mold production runs at a very high speed, some mold

breakdowns and damage have occurred in the past. Therefore, this mold diagnostic system has been developed in order to prevent such occurrences. The system employs ultrasound sensors and analysis equipment to check irregularities and assign numerical rating per shot. There are always symptoms before a mold breaks down or becomes damaged. The system identifies these symptoms and notifies an operator. Preventive maintenance has eliminated major mold damage in recent years.

Since the monitoring in the molding factory produces an enormous amount of data, the difficulty lies in how to convey it to operators and managers when a problem occurs. Since one machine produces 10,000 parts in one day, the relevant information needs to be conveyed immediately after a problem arises. A system has been set up in the molding factory to send a real-time audio message to a transceiver of an operator, and an email to the manager's PC. Even if the operator is performing other tasks in a separate location of the factory, he/she will know right away if there is a problem. Moreover, though machines operate with no one around in the mold factory at night or on holidays, an alarm email is sent to the cellular phone of the factory manager in the event of any trouble.

Yamagata Casio has pursued the greatest competitive edge in

monozukuri manufacturing technologies in Japan by connecting the entire plant via a digital network and compiling various kinds of production data. The company is now determined to keep moving forward, striving to achieve the greatest competitive edge in the world in manufacturing technologies.



Yamagata Casio

Key Person

Taking on the Challenge of Creating *Monozukuri* Manufacturing Technologies for People on Site: How to Work Smarter, Not Harder



Toshihiko Kuroda
Mold Making & Molding Division
Yamagata Casio, Co., Ltd.

In the Digital Network System recently developed by the Mold Making & Molding Division, I was in charge of integrating processing information such as paper drawings and production instructions into 3D data to develop a completely paperless mold drawing system that could be accessed whenever needed.

While developing this system, I focused my energies on how people on site can work smarter. It is natural for mold production to have paper drawings, and there is a unique culture in which high-level technicians understand and perform tasks that cannot be shown explicitly on a drawing. To abolish that source, paper drawings, I had difficulties in seeing processing know-how inherited for many years in a new light.

However, owing to the enthusiasm and teamwork of members involved in mold production, I managed to accomplish my task.

Our customers have expressed astonishment and admiration at the sight of skilled technicians making molds only by computers without any paper drawings in a factory. But I feel most rewarded by the gratitude of my colleagues—people actually working on site.

Although Japanese manufacturing faces a very challenging environment, I would like to pursue *monozukuri* and contribute to our business expansion.