

**Striving Constantly for Higher Levels of Precision through Extensive R&D**



**PROCESS-RELATED R&D**

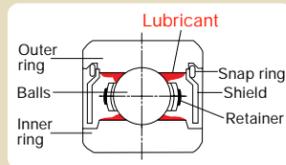
Takayuki Yamagishi, Senior Managing Director, General Manager of 2nd Manufacturing Headquarters and Hamamatsu Manufacturing Unit

Minebea's unmatched machining technologies have made it the most competitive manufacturer of ball bearings and precision components in the world. The Company thus places a high priority on R&D aimed at enhancing these technologies.

Minebea manufactures the bulk of its miniature and small-sized ball bearings and small motors and other components at its mass-production facilities in Southeast and East Asia under its unique vertically integrated manufacturing system. This system also allows the Company to apply the results of R&D carried out at parent plants in Japan swiftly and effectively to production elsewhere in Asia. Minebea thereby ensures the same level of product quality at all plants.

**T O P I C**

**In-House Development of Lubricants**



Lubricating greases and oils are used to prevent metal friction between the inner and outer rings and the balls in a ball bearing, thus ensuring smooth rolling and long bearing life. By capitalizing on its know-how and experience as a leading manufacturer of miniature and small-sized ball bearings, Minebea has begun developing its own high-quality lubricants at the Thai R&D Center. The Company is confident that these efforts will contribute to significant improvements in the quality of its ball bearings.

**R&D Center, Thailand**

Minebea's Thai R&D Center is located within the Bang Pa-in site, one of four manufacturing sites in Thailand that together account for approximately 60% of the Company's total production volume worldwide. Equipped with state-of-the-art analytical instruments, the center aims to resolve problems that affect precision and develop solutions that can be applied promptly and effectively on the production floor. The Thai R&D Center's activities focus on contamination control and material science, and are aimed at ensuring the reliability of finished products.

**Materials Analysis Using X-Ray Photoelectron Spectrometer**



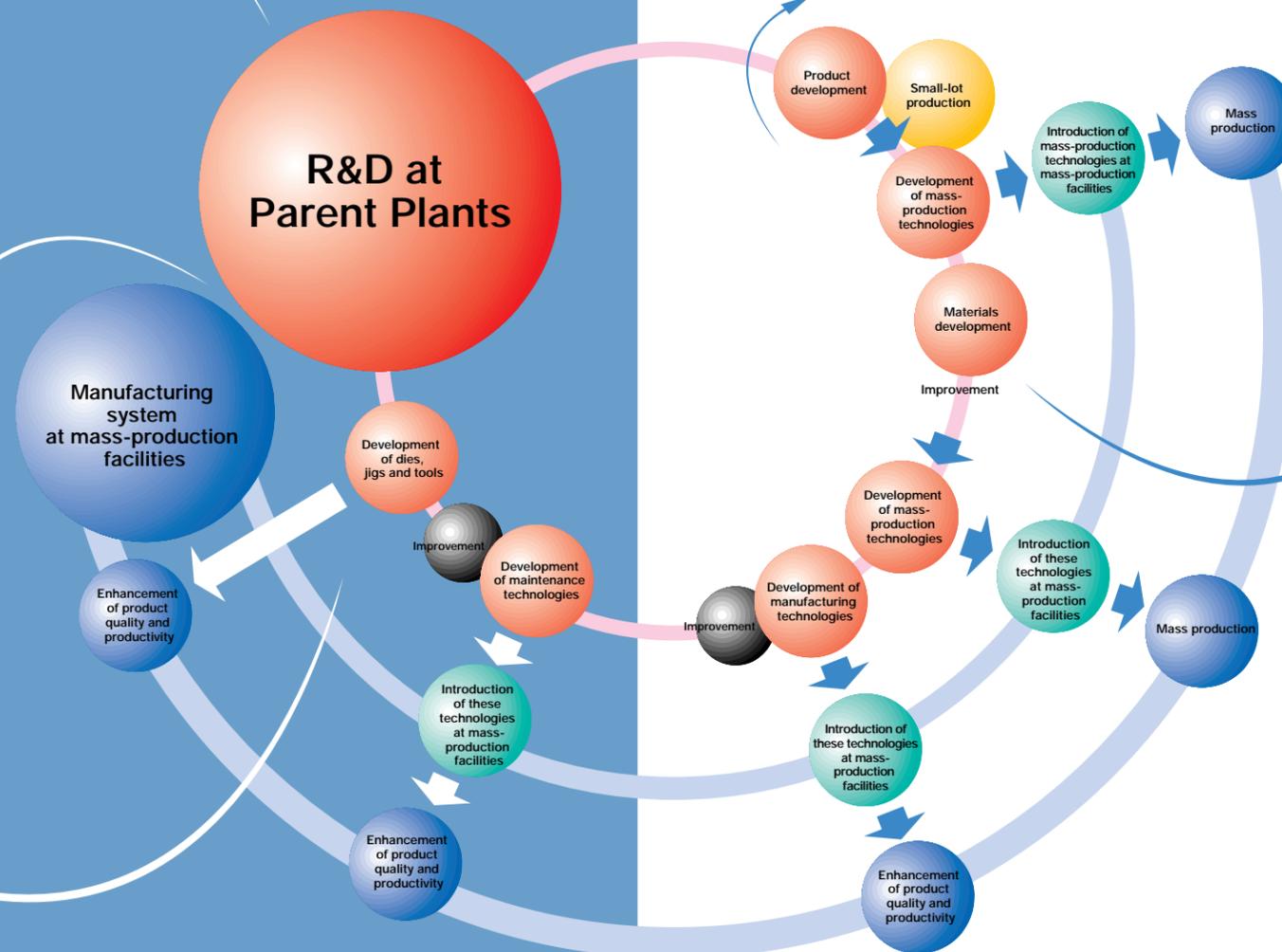
X-ray photoelectron spectrometers are used to investigate the surface chemistry and interactions of solid surfaces of metal and organic materials. The Thai R&D Center's X-ray photoelectron spectrometer enables researchers to determine, for example, whether metal discoloration is the result of oxidation or corrosion caused by chlorine, sulfur or other substances.

**Outgas Analysis Using Gas Chromatograph-Mass Spectrometer (GC-MS)**



GC-MS is widely used to determine the chemical properties of substances. At the Thai R&D Center, researchers use the GC-MS to analyze gases released by the adhesives used in spindle motors, enabling them to identify gases that could potentially lead to functional problems for HDDs in field use.

**R&D at Parent Plants**



**Minebea's Global R&D Network**

Minebea has established a global network of facilities to conduct R&D and testing in key product segments, thus facilitating swift and accurate responses to customer needs.



- **Karuizawa Manufacturing Unit (Japan)**
  - Product development (bearings, small motors and other products)
  - Technological development (manufacturing and mass-production technologies)
  - Product analysis and evaluation
  - Support for overseas R&D activities



- **Hamamatsu Manufacturing Unit (Japan)**
  - Materials R&D
  - Product development (electronic devices and components)
  - Technological development (manufacturing and mass-production technologies)
  - Support for overseas R&D activities



- **Thai R&D Center (Thailand)**
- **Singapore R&D Center (Singapore)**
  - Chemical analysis, cleanliness evaluation and acoustic testing of HDD components and other products



- **Minebea Electronics (UK) Ltd. (United Kingdom)**
- **Power Systems, Inc. (United States)**
  - Design and development of switching power supplies



- **Precision-Motors-Deutsche-Minebea-GmbH (Germany)**
  - Design and development of various precision small motors, notably spindle motors for HDDs



- **NMB (U.K.) Ltd., Airmover Division (United Kingdom)**
  - Design and development of fan motors



- **New Hampshire Ball Bearings, Inc. (United States)**
- **Rose Bearings Ltd. (United Kingdom)**
  - Design, development and production of aircraft bearings for customers in the United States and Europe—the world's two largest aerospace markets



- **NMB Technical Center (United States)**
  - Evaluation and testing of ball bearings for various customers, notably the Big Three U.S. automakers



- **Fujisawa Factory (Japan)**
- **NMB Technologies, Inc. (United States)**
  - Design and development of PC keyboards

