

Interview with NSK's Head of Technology

Offering new value with final users in mind through the strengths of our core technologies.

Executive Vice President
Head of Technology Development
Division Headquarters

Nobuo Goto



Q1

What are NSK's technical strengths?

"Tribology" is the foundation among NSK's "Four Core Technologies." Tribology is the study of interactions of component surfaces in motion. In bearings, these include the rolling elements and rings that support machine rotation. Tribology technologies improve performance by controlling friction and abrasion. The second core technology is "materials." These include optimization of special steels for high-performance rolling elements and rings, and heat and surface treatments. Material technologies also allow grease and resin to achieve their full potential. The third core technology "numerical simulation" uses computer simulations to reproduce tribology phenomenon. Finally, the fourth core technology "mechatronics" utilizes computer control to leverage the strengths of individual machines for high performance.

Over NSK's 100-plus year history, we've done painstaking scientific research into the first three core technologies and their relation to contact points. These points, present in even large machines, are no bigger than the size of the hole in a Japanese five-yen coin (about 5 mm). To provide the best for our customers, we've delved into tribology and materials, used computers to simulate occurring events, and in turn

narrowed down possible solutions. Applying these high-level approaches to rotating elements and machine components is, in my view, NSK's greatest technological strength. Based on this strength, NSK has applied technologies that increase performance including extending lifespans and lowering torque to products in various fields and has built up a successful market record. Another example is electric power steering (EPS), which assists drivers via mechatronic-based computers and motors. NSK has used "mechatronics" to expand its product lineups beyond pure mechanical components, which I think is another strength.

Recently, production technology has become another important technology and strength of NSK. Even though NSK has four core technologies, production technology must ultimately also be included. As such, we have started to use the phrase "4+1." No business will prosper unless it provides high-quality products with the right costs and prices. This is where production technology comes into play. Through 4+1, NSK's technological skills have received high marks worldwide, and we continue to build on our achievements.

Q2

What are NSK's technological issues?

NSK handles components such as bearings and ball screws that control the basic elements and functions of machines. However, we're not satisfied with just providing components that meet customer-required specifications. Rather, we want to provide value through specialized products based on how our components are ultimately used and what end users need.

In automotive components for instance, our approach to product proposals naturally changes based on what makes drivers happy, comfortable, and safe. In industrial machinery as well, gaining an understanding of the configuration of equipment, like injection molding and die casting machines, along with the needs of specific industries will help us to solve social issues.

These include lowering energy consumption and reducing CO₂ emissions, as well as meeting Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) factors. From an engineering and marketing perspective, this is an important concept for business expansion. Of course, our forward-looking proposals do not always work out or satisfy customers. When our proposals fail to grasp customers' essential needs, we create new proposals based on customer feedback and analyze what we missed. Though we're already taking such actions, we must become more familiar with this approach and strengthen our efforts.

Q3

Technological revolutions in areas such as IoT and AI are moving fast. What value can NSK provide to society, the market, and customers during these changes?

The automobile industry is undergoing a dramatic technological revolution. Against this backdrop and within the overarching trend toward CASE (connected, autonomous, shared, electric), I think NSK can fully contribute to autonomous driving and automotive electrification. Of course, issues remain in how to effectively control electricity consumption and get the most out of vehicles. Performance requirements for low friction, compactness, light weight, high speed, and low noise are becoming increasingly hard to reach. Even so, we will contribute to these areas by developing and providing customers with high-value-added bearings. Moreover, we are developing and proposing Traction Reducer to many customers. These high-efficiency speed reducer systems enable ultra-fast rotation in electric-drive units. We contribute to existing machine elements such as automatic-brake ball screws, which help keep people safe during automated driving. We're also engaging in technical development of steer-by-wire next-generation steering systems in which the handle and steering mechanisms are not physically connected. In actuation, which is vital for vehicle operations, we have released the Concept

for Flex Corner Module that integrates driving and steering. I expect that the fields where we can use our technologies and products will continue to expand.

As for industrial machinery, we'll continue to provide value to industrial sectors by developing bearing and ball screw products with greater performance and that contribute to society based on NSK's core technologies. In addition, we aim to create new value through initiatives in emerging fields new to NSK, such as biotechnology and healthcare. Providing essential components alone is not enough to do business in these fields. Instead, NSK seeks out complete solutions. We've made LIGHBOT™ guide robots for the visually impaired and are developing system units in biotech fields where fine operations are required. In addition, we're engaged in joint initiatives with WHILL, Inc.*, a next-generation personal mobility systems company. Along those lines, in November 2017 NSK invested in SoftWheel Ltd.*, an Israeli personal mobility wheel maker for such products as wheelchairs and bicycles. Through these actions, NSK has begun to seek out opportunities to provide new value in emerging fields.

*For more details on WHILL, Inc., and SoftWheel Ltd., please refer to the following press releases:
WHILL, Inc.: <http://www.nsk.com/company/news/2017/press0404b.html>
SoftWheel Ltd.: <http://www.nsk.com/company/news/2017/1107a.html>

Q4 What are your thoughts on the Technology Division's global framework and role sharing, use of external resources, and collaboration?

While NSK has 15 R&D centers worldwide, base technologies and new product development are centralized in Japan. As these have reached the application level, we offer them through customer contact points at our overseas tech centers. We're also taking steps to share tools at development centers in different regions in order to provide the same level of technical service for bearings anytime and anywhere. At the same time, to better utilize global human resources in steering systems, we've established a common skill matrix and are preparing a system for optimally assigning engineers to individual projects. With a core of members based in Japan, personnel familiar with steering technology in five locations (Europe, the United States, China, India, and Thailand) share issues for improving technical services and are forming teams based on the skill matrix and regional needs.

Looking ahead, NSK will proactively adopt technologies it lacks from external sources to develop new products for new businesses and fields. With the "Four Core Technologies" in mind, NSK will choose fields poised to expand rapidly as initial entry points by further enhancing external technologies and addressing weak points. With changes in biotechnology, healthcare, and robots accelerating, we have to take such actions to develop products quickly. To survive in these markets however, NSK must also use its own strengths to create unique products. We will make decisions on technological development accordingly as



we closely examine NSK's strengths and the impact of entering these markets.

In addition, we'll also proactively take advantage of open innovation. For example, putting an idea of computer controls into a concrete shape including product technology requires cooperation from suppliers and business partners based on the scope of the field and speed of progress. By calmly analyzing NSK's strengths and weaknesses along with those of our partners, we can search for compatible partners in Japan and overseas and, in turn, build a framework for effective collaboration.

Q5 How is technology "Setting the Future in Motion"?

First, I want to again mention our efforts to develop new automotive technologies and products. Our ideas and technologies are steadily taking shape by identifying industry needs, such as electrification and automated driving, and taking the lead in development.

We also established the New Business Development Enhancement Office and New Field Products Development Center in 2016 in order to combine existing NSK technologies to seek new business opportunities. These include target segments where NSK was previously not directly involved in the market, such as biotechnology, healthcare, and robotics.

Also, I think we'll need new base technologies in different areas. These newly required technologies are called the "new core," and we must develop and keep them strictly in-house. We are considering a number of new candidates for NSK "new core" technologies while imagining future trends. Examples include functional materials and software for developing neural networks. With computer control becoming increasingly common, software technology is an extremely important field in my view. In addition to our core business in machine elements, from now I hope for us to further expand into actuator and system products.