Review

Strategy on Research & Development at Nippon Steel Corporation

Naoya HAMADA*

1. Introduction

The research organization of Nippon Steel Corporation originated in the Research Section that was initiated in the government-managed Yahata Steel Works in 1916. The research section was restructured to form a research laboratory in 1919. As quoted in an article written for this Centennial Commemorative Issue, the purpose of the research laboratory was to "administer all matters relating to technical research." More specifically, the research laboratory was intended to "study problems involved in improving or advancing the operations of the works and promote the technology development by matching theory and practice while maintaining close contact with the individual plants at all times," and "carry out scientific research required by the works and at the same time, implement industrial research, interlock them with the said scientific research, achieve the research objectives and direct useful research results to the appropriate works." Thus, while emphasizing on the actual works and products, the research laboratory was oriented to provide basic solutions to diverse problems on the basis of fundamental principles. In addition, the research laboratory was proud of its achievements and asserted that "We are not conducting research just to publish reports," and "Quite a few of our research results have proved useful not only for Yahata Works, but also for the Japanese steel industry as a whole." The author admires the above philosophy, which is considered universally valid even today.

Nippon Steel Corporation was founded in 1970. Six months later, the company launched a Research & Development Bureau and established an organization to manage large-scale development projects, enhance research into technologies for product utilization, and implement integrated control of company-wide technical activities, from basic research to applied research and practical application.

In 1991, the company embodied its philosophy of "Technological innovations underlie its business administration." In particular, to enhance the competitiveness of its steelmaking business and practice multifaceted business management through the expansion of its business sphere, the company merged the steel research departments and plant engineering departments in Futtsu City, Chiba Prefecture. These departments had previously been distributed across the country. The company then integrated these departments with the technical research laboratories installed at its individual works to establish the Technical Development Bureau. The current structure of the Technical Development Bureau was established at that time, with the exception of the plant engineering departments, which was relocated to the Head Office as part of the November 2011 reorganization.

Since then, through the division of its main businesses into independent companies, Nippon Steel has promoted a consolidated management setup with itself as the holding company. As a result, the Technical Development Bureau has been positioned as a corporate function for the entire Nippon Steel Group.

In this article, I focus on the present Technical Development Bureau and describe the research and development (R&D) strategy, including the R&D policy, organization, and administration as well as governmental/industrial/academic cooperation and intellectual property.

2. Roles and Policy of the Technical Development Bureau of the Nippon Steel Group

The Nippon Steel Group is a corporate entity consisting of six business segments (steelmaking, engineering, urban development, chemistry, new materials, and system solutions) with steelmaking as its core. The basic philosophy of the Group is "With the steelmaking business at its core, the Group shall contribute to industrial progress and improved living standards through the creation and supply of high value."

To help embody the above philosophy, the Technical Development Bureau performs R&D functions not only for the steelmaking business but also for the entire Group (**Fig. 1**). Moreover, it is currently conducting numerous research themes in the form of consigned research or joint research with nonferrous-segment companies. The Bureau aims to augment the overall strength of the Nippon Steel Group by performing the above activities, strengthening ties among the six business segments, and enhancing the value of the consolidated companies by proposing complete solutions to customers. With "seeking technological forwardness" as its basic policy, the Bureau has four main pillars: (1) Development of high-function products in the field of high-grade steels by considering the polarization of the

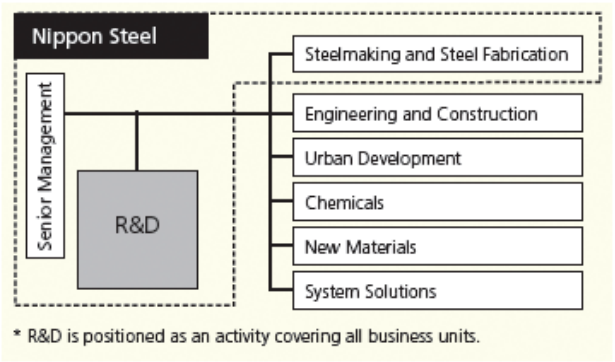

Fig. 1 Positioning of R&D in Nippon Steel Group

* Executive Counsellor, General Manager, Ph.D., Technical Development Planning Div.
20-1, Shintomi, Futtsu, Chiba 293-8511

steel market, (2) Development of processes that will significantly reduce costs, (3) Development of environmental technologies that will enable the sustainable growth of the member companies, and (4) Research and development in nonferrous fields to augment the overall strength of the Group.

3. Research and Development Organizations[1)]

The Technical Development Bureau consists of a central research function and a local technical research function. As the central research function, the Steel Research Laboratories, Advanced Technology Research Laboratories, and Process Technology Center are concentrated in the neighborhood of Kimitsu Works in Futtsu City, Chiba Prefecture. In addition, a local technical research organization is installed in each of the main works. The Plant Engineering & Facility Management Center of the Head Office has also been located to Futtsu City. All these R&D organizations collaborate closely to implement basic research and applied R&D and build commercial production equipment in order to put newly developed technologies into practical use as quickly as possible (**Figs. 2** and **3**).

The Steel Research Laboratories have been pressing ahead with a wide range of R&D, from developing new products that are adapted to specific customer needs to designing structural members and proposing solutions. In particular, by exploiting phenomenon analysis, microscopic material design, and advanced numerical simulation technologies—which are all indispensable for manufacturing products, the Steel Research Laboratories investigate the ideal shapes and functions of materials and structural members, develop new products that are environmentally friendly and significantly contribute to society, and establish the technologies required to manufacture such products.

In fields ranging from steel and nonferrous materials to energy and the environment, the Advanced Technology Research Laboratories is engaged in the research of advanced key technologies for the entire Nippon Steel Group, including basic material technology, basic process technology, material characterization, and mathematical science. The technologies acquired by the Advanced Technology Research Laboratories support the development of various materials, including bonding wires, microballs and other semiconductor packaging parts, SiC single-crystal wafers, fine ceramics, laminated films, catalysts for exhaust gas purification, and the development of new processes, such as gas to liquids as well as other energy transformation processes and advanced water treatment technologies. By constantly considering the trends in the society and markets, this organization focuses on the development of original technologies and products.

The Process Technology Center is involved in the fields of energy, environment and resource recycling, as well a new technology development for ironmaking, steelmaking, and rolling. In addition, the Center develops process analysis, quality measurement, production scheduling, and laser application technology to support the above activities.

The Plant Engineering & Facility Management Center shoulders company-wide responsibility for plant engineering/technology and equipment maintenance in plant relating to ironmaking, steelmaking, rolling, and energy as well as in supporting fields such as factory automation, mechatronics, refractories, system control technology, civil engineering, architecture, and water supply technologies.

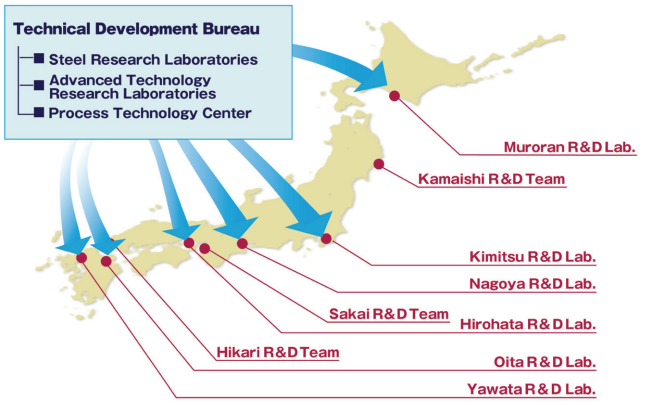

Fig. 2 Location of each part of Technical Development Breau (as of Nov. 1, 2011)

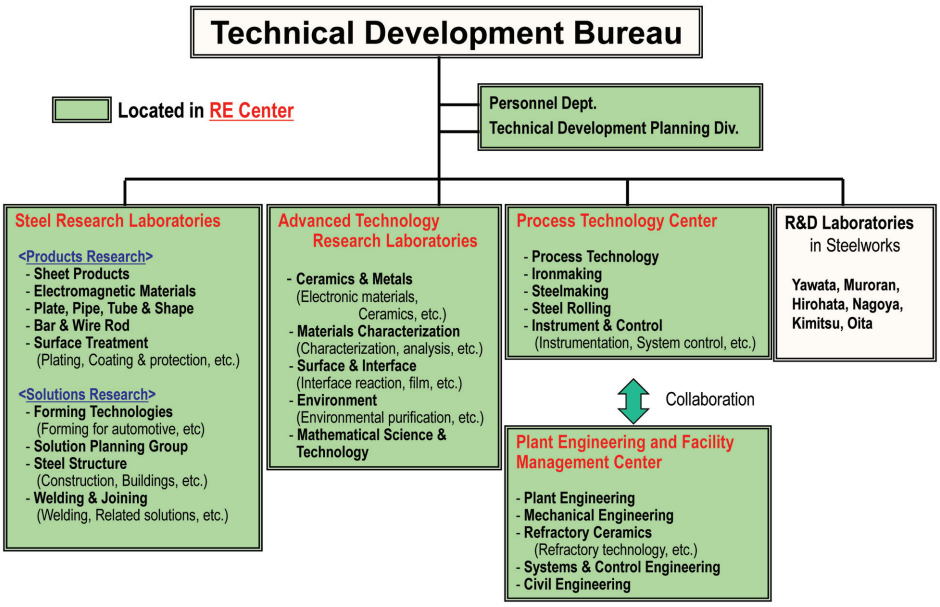

Fig. 3 Organization chart of Technical Development Breau (as of Nov. 1. 2011)

Moreover, this center performs an integrated R&D-E function in cooperation with the Process Technology Center.

Furthermore, the local technical research function consists of R&D labs installed at Yawata, Muroran, Hirohata, Nagoya, Kimitsu, and Oita Works. To provide adequate technical support for the works, each R&D lab promptly meets requests from the frontline, such as improving products/equipment, and applies the results obtained at the above laboratories to commercial production equipment. Acting as an intermediary between the frontline plant technology and the laboratories, individual R&D labs at the steelworks are engaged in wide-ranging R&D that requires continual and close attention to user needs, thus aiding in developing new products.

Overall, Nippon Steel's strength lies in the following:

1) Total power and speed of development through the integration of R&D sites and practical application of R&D results.
2) Proximity of R&D labs at steelworks to customers and an established organization to support and cooperate with customers.
3) Ability to propose complete solutions that embrace products and technologies of member companies within the Nippon Steel Group.
4) Ability to respond to various environmental and energy problems by exploiting steelmaking process technology.
5) Promotion of industrial—academic cooperation and joint research with overseas alliances and customers at home and abroad.
6) Accumulated assets of fundamental research results.

Capitalizing on the above advantages, the Technical Development Bureau develops new functional products on the basis of steel and innovative new production processes and strives to put them to practical use as quickly as possible.

4. Research and Development Administration[1)]

To achieve two objectives, namely promoting R&D linked more strongly to management/business strategies and pursuing advanced and innovative themes, the Technical Development Bureau, while determining R&D themes to be executed, divides the themes mainly into "product/works themes" (consigned R&D) and "voluntary research themes" (voluntary R&D) (**Fig. 4**). In particular, for consigned R&D, the business and technical development departments thoroughly discuss the needs, development targets, and deadlines of each theme before they decide on executing it on the basis of their mutual understanding and common recognition. In addition, to positively obtain the required R&D result, the "concept of contract" has been introduced (**Fig. 5**). For R&D themes that demand company-wide support for theme selection, progress monitoring, and result evaluation, "corporate strategic themes" have been set separately (Fig. 4).

For formulating an R&D plan, the headquarters of the concerned departments (the Technical Administration & Planning Division and relevant divisions) and the Technical Development Bureau conduct individual and joint discussions on R&D themes presented by individual divisions and works. Then, the Technical Development Bureau prepares a general R&D plan on the basis of the proposed R&D themes and voluntary R&D themes; this plan is submitted to the corporate deliberative council (the technical development committee) for approval. In the deliberation process, emphasis is placed on discussing individual plans at the formulation stage and clarifying the direction of long-term R&D activities. The procedure for reviewing a specific R&D theme during execution has been simplified, and decisions on matters such as "Stop" or "Go" are made flexibly and speedily. Certain R&D themes are managed voluntarily and dynamically and are the responsibility of the head of the research organization. In particular, due consideration is given to the importance of fundamental and exploratory studies.

R&D themes involving two or more divisions in growing fields such as energy, environment and infrastructure are conducted as company-wide themes in order to propose complete solutions by considering existing social needs.

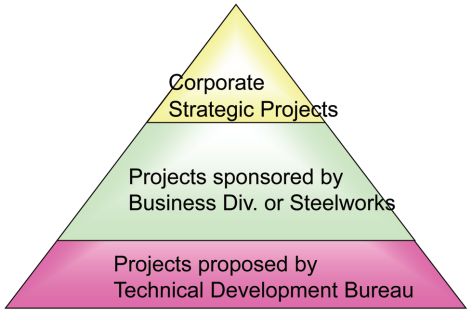

Fig. 4 R&D projects classification

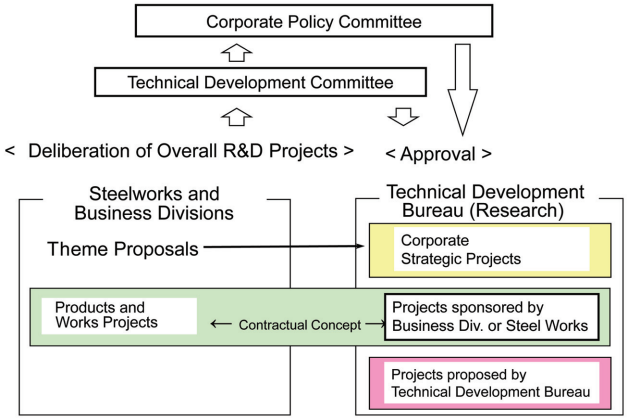

Fig. 5 Roles and responsibilities on R&D activities

5. R&D Activities

The Centennial Commemorative Issue describes the past thirty years of product development, steelmaking process development, engineering activities, development of supporting common fundamental technologies, fabrication of nonferrous materials, and challenges to environmental problems as well as the direction of future R&D activities. Below is an outline of these activities.

5.1 Seeking functions and applications of steel

In the field of automobiles, Nippon Steel has forged ahead with the development of complete solutions for materials, processing, and jointing in order to meet the apparently contradictory demands of better fuel efficiency (reduce environmental burdens) and higher crash safety of vehicles. In addition, the company engages in the development of regulations on emissions such as NO_X, and SO_X and applies numerical calculation technology to optimize structures that help customers (automakers) to shorten their development periods.

In the field of shipbuilding, Nippon Steel has successfully responded to the increase in the strength of steel structures and has developed fine-grained HAZ steel using TMCP for large heat inputs that permit customers to perform efficient welding operations. In construction equipment and industrial machinery fields, the company has developed high-tensile steels for machines that are larger in size

and smaller in weight as well as wear-resistant steels for machine parts that are subject to marked abrasion due to interactions with rock and sand. In the fields of home appliances and office automation equipment, the company mainly offers surface-treated steel sheets for improved corrosion resistance (extended service life) and enhanced aesthetics. Moreover, it has developed pre-coated steel sheets that permit customers to omit degreasing and coating processes, thereby reducing manufacturing costs and offering products that help reducing emissions of environmentally hazardous substances as well as products provided with new functions such as good design and static resistance.

In the field of infrastructure (roads, railways, rivers, architectural structures, and houses), Nippon Steel has forged ahead with the development of new products and solutions in response to the increasing demands of lower costs, with utmost consideration given to ensuring safety and security against natural disasters, for example, increasing strength and improving seismic resistance to enable construction of larger-scale infrastructure. In the field of energy and the environment, in addition to oil well pipes, line pipes, and high-strength high-toughness steels for offshore structures that are indispensable for the production and transportation of fossil fuels such as oil and coal, the company has developed ultralow-temperature steels for LNG tanks, which are required to have a high fracture strength at extremely low temperatures, and heat-resistant steels for power plants with excellent high-temperature creep characteristics.

5.2 Mastering steel manufacturing technologies

In the field of ironmaking, to cope with dwindling natural resources, environmental problems, and the growing demand for cost cutting, Nippon Steel has developed technologies to utilize resources of inferior quality, protect the global environment, conserve energy, improve the productivity of large blast furnaces, and prolong equipment life. In the field of steelmaking, in response to the diversification of steel functionality required by customers and the need for cost cutting, the company has been pressing ahead with measures to increase production capacity mainly through converter and continuous-casting processes, improved product quality, automated manufacturing processes, labor force reduction, environmental protection, and energy conservation. In terms of rolling, to respond to increased production capacity, improved product quality, and new product development, the company has developed new rolling processes and computer-assisted rolling control technology that is supported by numerical simulation and thermal control technologies. In steel processing field, with the aim of simultaneously achieving along-the-length, across-the-width uniformity of steel sheets and high productivity, the company has streamlined the related processes and developed technologies such as continuous annealing, continuous hot-dip galvanizing, and technology to manufacture steels for containers.

Regarding furnace materials (refractories) that are indispensable for high-temperature processes, Nippon Steel has developed technologies to prolong the life of refractories for bottom section of blast furnace, dry refractories using microwaves, and flame-gunning repairs, etc. Concerning machine technology, the company has forged ahead with the development of diagnostic technologies for equipment and technology that prolong the useful lifetime of steelmaking equipment, with the aim of ensuring the stable operation of production equipment and a reduced maintenance cost. In the field of measurement, control, and system technologies, the company has introduced high-precision measurement and automatic control based on advanced control theory and physical models in order to ensure an accurate and efficient supply of high-quality products. In addition, it has developed a new technology to support factory operations from a “human” viewpoint and a technology to develop inhouse software for a complete system comprising electrical equipment, instruments, and computers. In civil engineering, architecture, and water treatment fields, the company has developed technologies that support integrated iron and steel works, including technology for relining blast furnaces, technology to enhance the efficiency of dust collection within a plant, and advanced technology for water treatment.

5.3 Quest for fundamental principles

For common key technologies that support the development of new products and processes, Nippon Steel pursues metallurgy, material characterization, mathematical science (including numerical analysis and applied mathematics), and phenomenon analysis technology. In the field of metallurgy, to control the microstructures of steels, which is one of the most important techniques for controlling steel properties, the company has performed a detailed analysis of changes in microstructures in the steelmaking processes of heating, processing, and cooling and has strengthened the basic understanding of the phenomena with the aid of quantitative prediction based on numerical calculations. To analyze steelmaking process behaviors that involve complex physical phenomena, the company positively applies mathematical science and technology, including numerical calculations and applied mathematics. In addition, Nippon Steel has developed advanced technologies to analyze various phenomena that are indispensable for the development of new products and solutions. In particular, the company has developed technologies to evaluate hydrogen embrittlement—which is an impediment to the enhancement of steel strength—in order to improve resistance to delayed fractures. Moreover, it has developed technologies for analyzing steel fatigue to improve weld reliability and for clarifying corrosion mechanisms and various phenomena through *in situ* observations of reactions in steelmaking processes.

5.4 Mastering use of various materials

By capitalizing on its numerous accumulated steel technology assets, Nippon Steel has also been actively involved in the technological development of various nonferrous materials. Because of its excellent corrosion resistance, titanium is widely used in various industrial plants, bridges, and offshore structures. In addition, newly developed titanium sheets with a unique appearance are being increasingly applied to roofs and walls of architectural structures. In the field of aluminum production, aluminum alloys with good press formability have been developed to meet the increasing demand for reduced vehicular weight. Regarding semiconductor packaging materials, Nippon Steel has developed lead-free solders in response to the tightening of environmental regulations and copper bonding wires in response to the hike in gold prices. Furthermore, from the standpoint of the effective utilization of electrical energy, the company has forged ahead with the development of large-diameter SiC single crystals as new materials for high-performance power devices that are expected to replace silicon. In the field of renewable energies, polycrystalline silicon for photovoltaic power generation and superconducting bulk materials for wind power generation have been developed. In the chemistry field, the company has developed new chemical products using coal tar and coke oven gas as raw materials. In addition to high-quality carbon black for tires, organic-inorganic hybrid materials with various properties have been developed.

5.5 Mastering environmental technologies

Since the commencement of the energy-saving efforts prompted by the oil crises in the 1970s, Nippon Steel has positively pursued

process innovations, maximum use of byproduct gases, waste heat recovery, and effective utilization of waste. In addition, with the aim of drastically reducing CO_2 emissions, the company has been involved in the development of environmentally friendly steelmaking processes and demonstration testing of eco-towns and hydrogen towns with steelworks as the core. As technologies that effectively permit the use of inferior resources in steelmaking processes, the company has developed and put to practical use technologies that employ large quantities of noncaking or slightly caking coal in coke ovens, selective pelletizing of limonite-based ore, and recycling of dust. Furthermore, to create marine forests of seaweeds by utilizing steelmaking slag byproducts, the company has developed a fertilizer composed of humus soil and iron sources. The fertilizer has already produced appreciable results in regenerating seaweed beds in coastal areas.

6. Industrial/Academic/Governmental Cooperation

6.1 Cooperation with universities and public research organizations

With the rapidly changing pace of the social environment and the varied degrees of difficulty of tasks being addressed, it has become necessary to effectively utilize diverse spheres of "knowledge" that are external to the company. Accordingly, it is important to accelerate the rate at which important issues are solved by positively promoting cooperation with universities as well as domestic and foreign public research organizations, thereby consolidating the foundation for R&D.

In fiscal year 2006, Nippon Steel set major strategic research themes that would be entrusted to universities. Since then, the company has conducted theme-oriented joint research in diverse fields with external research laboratories and universities. At any given time, at least two concerned research departments of the company are involved in the above joint research. In many cases, the technical development planning department participates in the project and tackles various themes ranging from basic to near-practical themes as well as very challenging ones.

To theoretically clarify a specific phenomenon or seek a different viewpoint, individual research departments have entrusted a significant amount of research to universities. With increasingly sophisticated social needs and complicated technical problems, the above partnerships with universities and public research organizations, such as the National Institute for Materials Science and RIKEN, are increasing conspicuously.

On the other hand, considering the recent trends in incorporated universities in Japan, the number of laboratories that promote research on basic structural materials such as steel is decreasing. This is especially noticeable in the field of steelmaking processes. With this in mind, Nippon Steel has initiated the establishment of partnership laboratories with universities in order to support basic research into structural materials and processes. In addition, the company has established partnerships with several universities to conduct research in fields such as energy and the environment, in which the company's knowledge of the steel industry should be helpful. For example, the company has established a partnership laboratory named "Studies on Creation of Environment-Friendly Materials" at the Tohoku University Graduate School of Environmental Science and has opened a joint research laboratory with Osaka University Graduate School of Engineering. Moreover, in fiscal year 2011, the company set up a partnership laboratory at Kanazawa University Faculty of Engineering. In addition, with the cooperation of other steelmakers, Nippon Steel has forged ahead with the strengthening of industrial—academic cooperation from the viewpoint of a business enterprise. This cooperation involves the fostering of able personnel from the fields of steel materials, processes, and energy and the environment through an endowment laboratory called "Environmental Management and Engineering" at the University of Tokyo, partnership laboratories called "Advanced Research and Education Center for Steel" (ARECS) at the Tohoku University Graduate School of Engineering, and "Steel Partnership Lecture" at Kyushu University Steel Research Center.

While engaging with young enthusiastic researchers (mainly associate professors and assistant professors) at the universities through the above activities, Nippon Steel re-recognized the importance of increasing the number of contacts between the industry and fields of basic sciences in Japan; these contacts are expected to further increase in the future. Therefore, in fiscal year 2010, the company started a support system for young researchers. The purpose of the support system is to widen the knowledge sphere of the company by strengthening partnerships with researchers of the younger generation, who can freely investigate diverse research themes, and to afford these researchers better opportunities to quickly become familiar with the industrial world.

To further advance its technological expertise amid the rapidly changing social structure and global environment, the company has always placed significant importance on the expansion of the base of theme-oriented research activities through industrial—academic cooperation. This concept applies both domestically and abroad. In view of our continual globalization, Nippon Steel intends to also strengthen ties with overseas universities and research organizations. To this end, it is important that the company always maintains its research potential at a high level and is able to effectively interact with experts outside the company. In this context, the mission of the Technical Development Bureau is very important.

6.2 National projects

To implement developments that are conducive to government-formulated policies or policy objectives of master plans for science and technology, R&D projects involving the private sector are conducted as national projects. Nippon Steel also intensively engages itself in various activities that help further the country's growth strategy.

As an example, the company participated in the development of next-generation coke manufacturing technology (SCOPE 21)[2]. With the support of the Ministry of Economy, Trade and Industry and the cooperation of eleven steelmakers and coke manufacturers, the Japan Iron and Steel Federation and the Center for Coal Utilization jointly promoted the development project. The R&D efforts lasted ten years from 1994 to 2003. The first practical equipment came into operation at Nippon Steel's Oita Works in May 2008. In this particular example, Nippon Steel submitted a proposal based on a new seed technology developed by its research department. In addition, this national project that looked ahead ten to twenty years was advanced. Hence, various problems involved in designing and building a full-scale pilot plant were solved and system operation tests with the pilot plant were conducted, leading to the development of practical equipment.

The company is also engaged in "R&D on Environment-friendly Steelmaking Processes" (COURSE 50 Project), which has been conducted under the New Energy and Industrial Technology Development Organization (NEDO) since the fiscal year 2008. As a measure against global warming, the project entails the development of technology to restrain CO_2 emission and separate and recover CO_2 in order to reduce its emission by around 30%. NEDO aims to put the technology to practical use and achieve widespread use by 2050.

In addition to these R&D projects in the field of energy and the environment, which require a sophisticated fusion of high-end technologies or large-scale experimental equipment as mentioned above, Nippon Steel intends to positively propose national projects mainly in the field of pioneering R&D in order to pave the way for next-generation R&D. The company also aims to propose projects in the field of technological development in order to standardize material evaluations and structural systems. Subsequently, these R&D projects will be executed and their results will be put to practical use, thereby meeting the needs of our society.

7. Intellectual Property and Global Alliance Strategies

7.1 Intellectual property strategy

For one of its management philosophies, namely "Continue striving to create new technologies and innovate with existing technologies to lead the world with the most advanced technologies," Nippon Steel has implemented an intellectual property strategy whereby its high-end technologies and techniques are patented as intellectual property and managed in accordance with its business strategy. As a result, in terms of the number of patents owned, the company is the frontrunner in the domestic steelmaking industry. As shown in **Fig. 6**, the number of patents owned by the company has been increasing steadily.

On the other hand, the business environment surrounding the company has been significantly changing in recent years. Accordingly, in order for Nippon Steel to remain the leader in domestic and overseas steel markets, it has become indispensable for it to press ahead with an overseas strategy regarding intellectual property by focusing on technologies that support the company's strengths; these include the "ability to manufacture," a "solid manufacturing foundation," and "technological advantages." One example of the above strategy is the doubling of the number of foreign patent applications, as shown in **Fig. 7**. By doing so, the company aims to secure tangible intellectual property assets across "three poles"—Asia, the Americas, and the surrounding Atlantic Ocean area.

Following the precedents of global corporations, the future intellectual property strategy will consider not only seeking patent rights (open approach) but also securing competitiveness or differentiation by keeping intellectual property in the form of know-how ("black-box" approach). Therefore, it is critically important to implement appropriate management of technical information. In particular, any technical information that should be kept strictly confidential must be completely controlled in accordance with the guidelines on business secrecy management.

For implementing a more comprehensive intellectual property strategy based on all above-mentioned points, much is expected of the Technical Development Bureau, which accounts for nearly 70% of all patent applications of the company. In the future R&D strategy, it is necessary that the research, business, manufacturing, and intellectual property departments work more closely and develop new products/manufacturing techniques that are adapted to specific customer needs. Moreover, these departments must deploy a positive intellectual property strategy while aiming to create new technologies to cope with hikes in the prices of natural resources and reduce emissions of environmentally hazardous substances.

7.2 Global alliance

To survive in this era of fierce competition among steel suppliers, which include emerging steelworks in Asia among other areas and meet the ever-growing demand for steel in the NIES and other countries, the Nippon Steel Group intends to consolidate its business bases both domestically and abroad. In addition, it aims to further expand the breadth and depth of its global production and supply network, which is already one of the largest among the world's major steelmakers. In particular, it plans to build a worldwide tripolar organization that embraces Asia, the Americas, and the surrounding Atlantic Ocean area (**Fig. 8**).

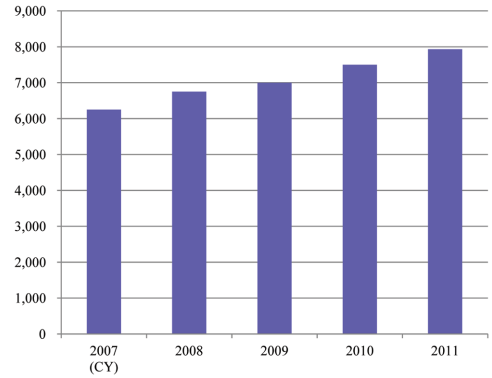

Fig. 6 Number of Japanese patents owned by Nippon Steel

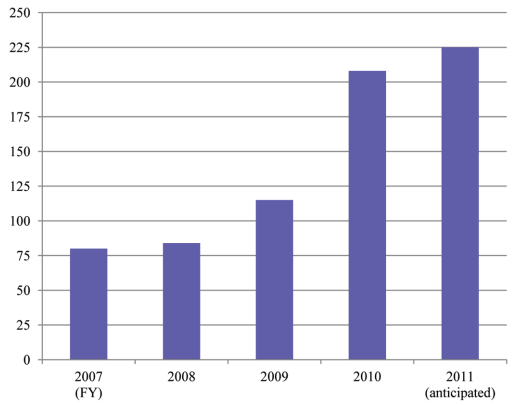

Fig. 7 Number of publications of international applications by Nippon Steel

For Nippon Steel to differentiate itself from the newly emerging steelworks in terms of its ability to cope with recent hikes in the prices of raw materials and utilize inferior raw materials, it is important that it expands its global network and enhances its capability to develop new technologies.

Through a global alliance with leading steel manufacturers in various overseas regions, the R&D departments of Nippon Steel actively conduct joint research to expedite their results. For example, the departments are promoting joint research with POSCO in South Korea in the environmental and steelmaking process fields and with Arcelor Mittal in Europe in the fields of automotive sheets and steelmaking processes.

8. Conclusion

The behavioral guidelines for employees of the Nippon Steel Group contain these passages. "Passion and Creation: We continue taking up every challenge with the aim of becoming the world's best manufacturer" and "Works and Actual Products: We strive to make

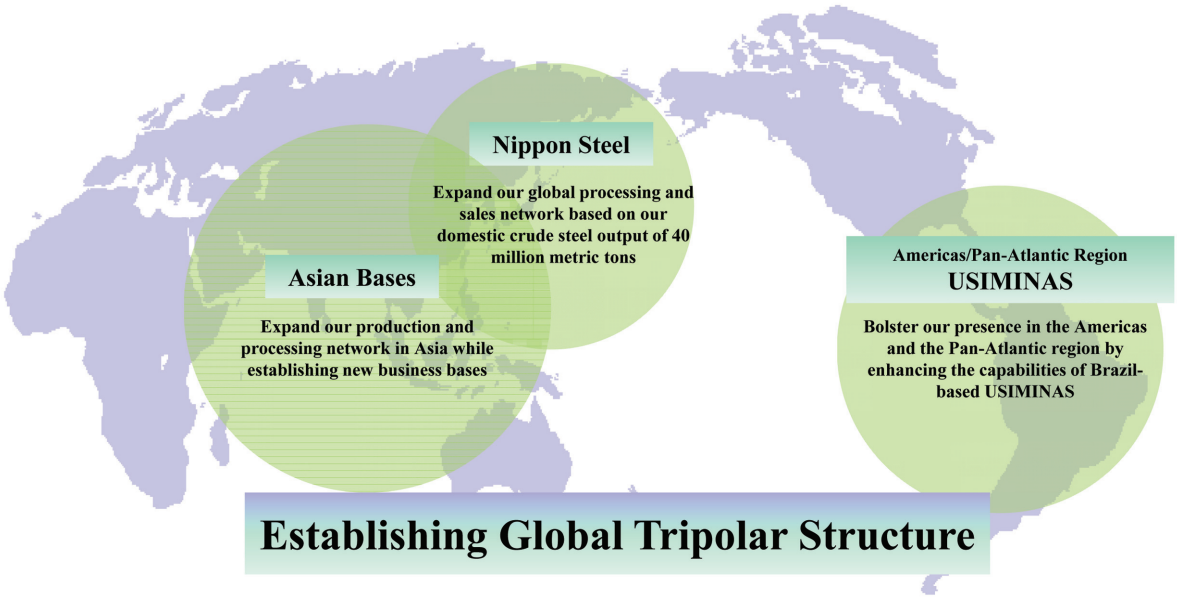

Fig. 8 Establishing global tripolar structure

continual improvements in our works in pursuit of the essence of our goods." These guidelines are the company's written philosophies that have been handed down since the inauguration of the R&D organization. They are also a source of strength for the Nippon Steel Group. The R&D strategy that has been described so far is the result of various sincere efforts to consistently develop and propose competitive new products and ensure their reliable and economic delivery to customers. For Nippon Steel to become a truly global business group with a corporate constitution, growth potential, and earning power befitting of the No.1 company in terms of overall strength amid increasingly rapid changes in the social environment, it is also necessary that our R&D strategy continues to evolve.

In particular, with the acceleration of customer globalization and changes in the business sphere, Nippon Steel as a materials maker will be required to propose complete solutions for the entire business domain of its customers beyond conventional product series. Such societal demands should be met by ongoing R&D to improve the properties of steels, establishing a setup for the efficient manufacture of high-quality steel products through innovations in the manufacturing process, and making the common key technologies for supporting them more sophisticated, while responding to global environmental problems and depleting natural resources. To this end, we intend to make the most effective use of the overall strength of the Nippon Steel Group and to further strengthen ties with the government, universities, public research organizations, and other alliance partners.

Japan's strength lies in the enhancement trade, and the nation has flourished because of its manufacturing industries. We believe that in the future, the role of our technical development departments will become increasingly important. In this context, the responsibility of the Technical Development Bureau, which plays a leading role in technological development, is significant. The Bureau is determined to continue attaching importance to "works" that advance the company's technological potential with "passion" and meet social needs.

References

1) Shinnittetsu Giho. Outline of the Technical Center. (347), (1992)
2) Nippon Steel Monthly. 2008.10

Naoya HAMADA
Executive Counsellor, General Manager, Ph.D.
Technical Development Planning Div.
20-1, Shintomi, Futtsu, Chiba 293-8511