On the Foundation of Research & Engineering Center

Dr. Tetsuro Ohashi
Director
Technical Development Planing Div.
Technical Development Bureau

1. Concept

As the industrial society advances with rapidly evolving technical innovation, there is a remarkable increase in the role to be played and responsibility to be shouldered by technology in corporate activities.

Japan, which has achieved high growth mainly on the strength of imported technologies, is now strongly called on to strengthen basic research and develop original technologies. Furthermore, the pursuance of ideal relationship between technology and economic activity is gaining importance on a global scale, as typically seen in the growing natural resources and environmental problems.

Under these circumstances, Nippon Steel has built in Futtsu, Chiba Prefecture, a new technology development base under the name of Research & Engineering Center. It has its aims in realizing the company's basic principle of "management founded on technical innovation", contributing to society in a wide range of sophisticated technologies, and creating new values in advance of the times.

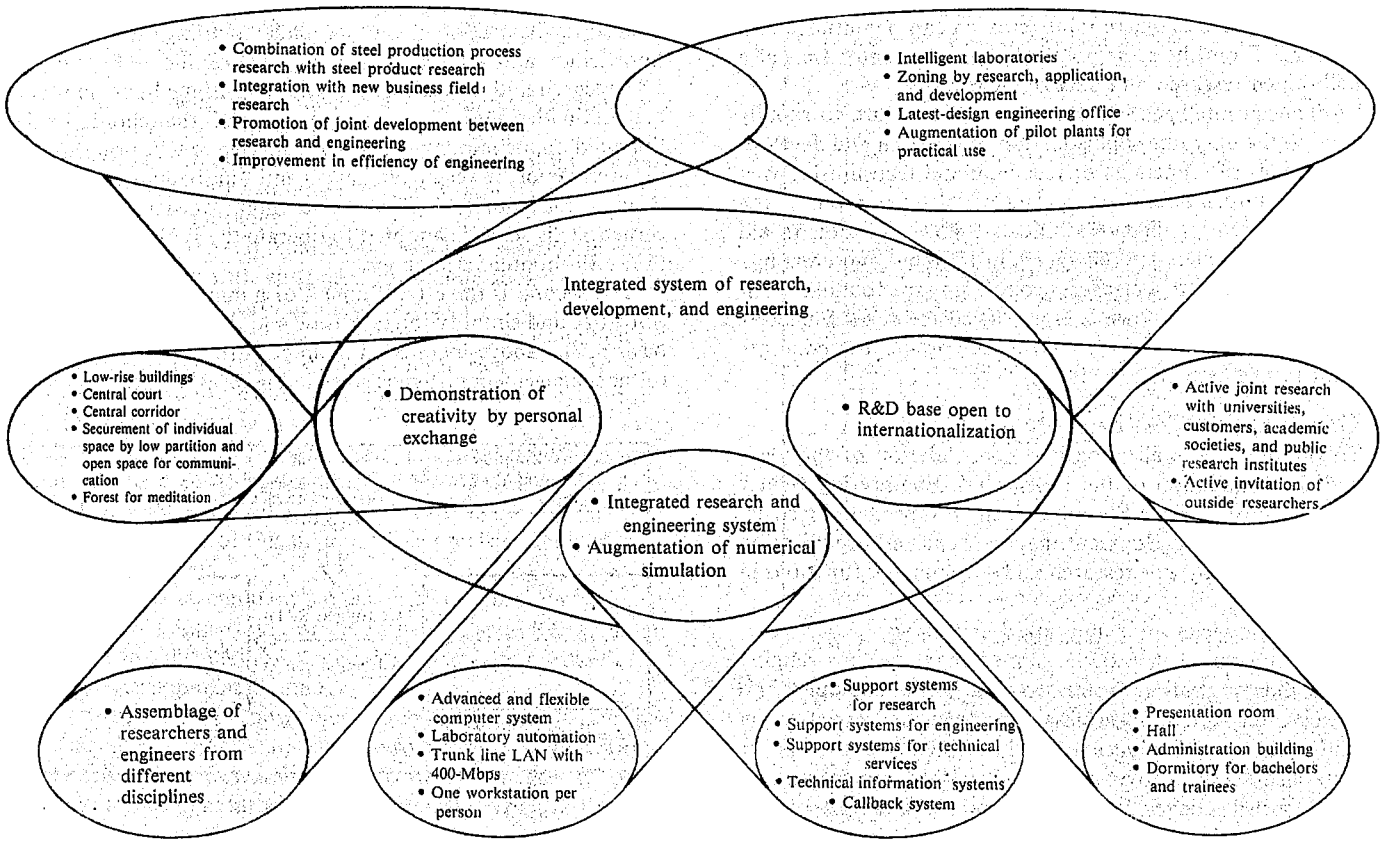


Fig. 1 Founding concepts of Research & Engineering Center

The new center consolidates the old iron and steel research divisions and plant engineering and technology divisions that have been scattered in various parts of Japan. In the future, new areas such as chemicals and advanced materials, and basic research functions will also be merged there to create an integrated research, development, and engineering base.

The Research & Engineering Center was founded under the considerations that hardware should befit the world's latest research and development organization, and software should emphasize personal exchange and creativity. **Fig. 1** shows the founding concepts of the center.

The basic concept is Research & Engineering in harmony realized in a comprehensive integrated research, development and engineering system.

Ideas originate in the character and conception of the individual researcher, but they can be translated into products or processes only through the cooperation of many persons and organizations. The "R&E in harmony" is indispensable for accomplishing this challenge.

This principal concept will be realized through:

(1) Demonstration of creativity through personal exchange
(2) Research and development base open to the outside
(3) Advanced intelligent facilities

Conception by an individual researcher is the starting point of any research work, but his exchange with others inside or outside the company, especially with those in different disciplines is important to make his conception a concentrate, realistic one. As seen in its low-rise buildings and central court, the Research & Engineering Center was built to provide such an atmosphere that customers and members of academic circles can readily visit. There are also places where joint research can be initiated and accelerated. From the same point of view, the center aims at a globally open research and development base.

"Advanced intelligent facilities" is one measure to rapidly respond to the on-going sophistication of research and development. Besides the functions of receiving and transmitting vast amounts of information from and to people in and out of the center, advanced intelligent facilities are powerful tools to aid individual researchers and engineers in thinking and creating.

Many other concrete measures comprising the founding concepts of the center are shown in **Fig. 1**. The Research & Engineering Center will endeavor to realize and expand the concepts through future activities.

2. Organization and Management

To promote the realization and consolidation of the ideas behind the foundation of the Research & Engineering Center described above, Nippon Steel drastically reviewed and restructured its technical development management and organization embracing companywide research and development functions in June 1991.

The basic policies are summarized as follows:

(1) Establishment of new R&D, management systems ranging from theme selection to result evaluation for the quick and efficient execution, and sure and pertinent industrialization with clear responsibility.
(2) Establishment of a dynamic technical development organization which enhances leading-edge basic technologies through challenges of innovative themes, and transmission of positive information to parties both inside and outside the company.

Consigned research and development themes	Autonomous research and development themes
• Companywide consigned themes	• Companywide autonomous themes
• Individual division consigned themes	• Individual autonomous themes

Fig. 2 Introduction of new conceptual categories for research themes

(3) Establishment of corporate culture where vigorous companywide debates take place on technical development through direct dialogues among corporate management and business divisions.

Some of the definite measures implemented to achieve the basic policies are introduced below.

First, new conceptual categories are established for the preparation and implementation of research and development themes (realization of such themes is an action of specific research and development projects). **Fig. 2** shows the conceptual categories. Research and development themes are divided into four categories. There are the two main categories of "consigned research and development" and "voluntary research and development".

These categories are more strictly defined and managed to accomplish the two purposes simultaneously; one is executing research and development under strong linkage with management and business strategies and the other is challenging leading-edge and innovative technologies themes. Especially for consigned research and development, the "contractual concept" is introduced between the business divisions and the research and development divisions to have thorough discussions about such details as needs, development goals and time limits, to decide on procedures on the basis of mutual understanding and common knowledge, and thus to achieve positive results.

Research and development themes, consigned or voluntary, are subdivided into "companywide themes" that should be deliberated on a companywide level from theme selection through progress report to result evaluation and "individual and general themes" that should be left to the autonomy of each division concerned. This setup is adopted to operate the R&D management in a well-modulated manner.

The second is the establishment of a management system to prioritize and simplify the task flow and the deliberation on the basis of the above-mentioned main classification. An overview of the management system is given in **Fig. 3**. When R&D requests

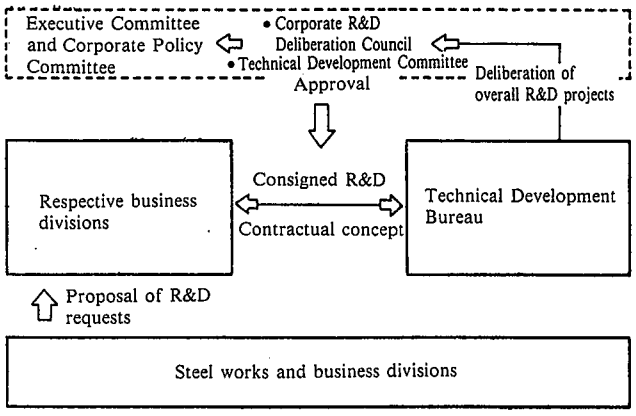


Fig. 3 Clarification of divisional role and responsibility for research themes

are proposed by business organizations and works, the functional divisions in the head office (such as the Technical Administration Bureau) discuss with the Technical Development Bureau about all individual research and development plans. The Technical Development Bureau compiles these several consigned research and development plans with the addition of voluntary research and development themes, which are deliberated and approved at companywide meetings such as the Technical Development Committee. When an R&D theme is deemed too risky for a single business division to undertake or involves two or more business divisions, it may be commissioned by the company itself. A new system is installed under which such themes are deliberated by the Corporate R&D Council as corporate research and development themes. This management system is designed for more powerful implementation of multiple businesses.

In these deliberation processes, emphasis is placed on deliberation not for a single year but for two or more years until the completion of the themes on the augmentation of discussions, and also on the clarification of future courses while still in the planning stage. Simplification of deliberation procedures, operational flexibility and rapidity, including the decision-making procedure, are important considerations in the implementation stage.

For "individual and general themes", management system is established under which the director or general manager of the laboratory concerned manages the project voluntarily and functionarily at his own responsibility. More profound considerations are especially given to research in both basic and searching areas.

Besides the establishment of the above-mentioned basic management systems, there also are several improved management systems within the Technical Development Bureau. Major ones are described below.

- Reinforcement and augmentation of planning functions concerning technical development
- Maximum utilization of the project methodology, including the scenario planning stage, and improvement in this project methodology
- Active promotion of consigned and joint researches in closer collaboration with customers, academic societies, foreign companies, and affiliated companies
- Clarification of roles and intensification of coordination between the central and works' laboratories
- Simplicity and flexibility of budget utilization by improving the accounting system

To attain the above-mentioned operational objectives with higher efficiency, the organization concerned with technical development was revised as shown in **Fig. 4**.

The main points of this organizational revision may be summarized as follows:

(1) To enhance the company's research and engineering activities through the integration of the former Central R&D Bureau and Plant Engineering & Technology Bureau into a new Technical Development Bureau

(2) For the primary purpose of deepening and accumulating specialized technologies, to establish four research laboratories, namely, "Steel Research Laboratories", "Process Technology Research Laboratories", "Advanced Materials & Technology Research Laboratories" and "Electronics Research Laboratories"

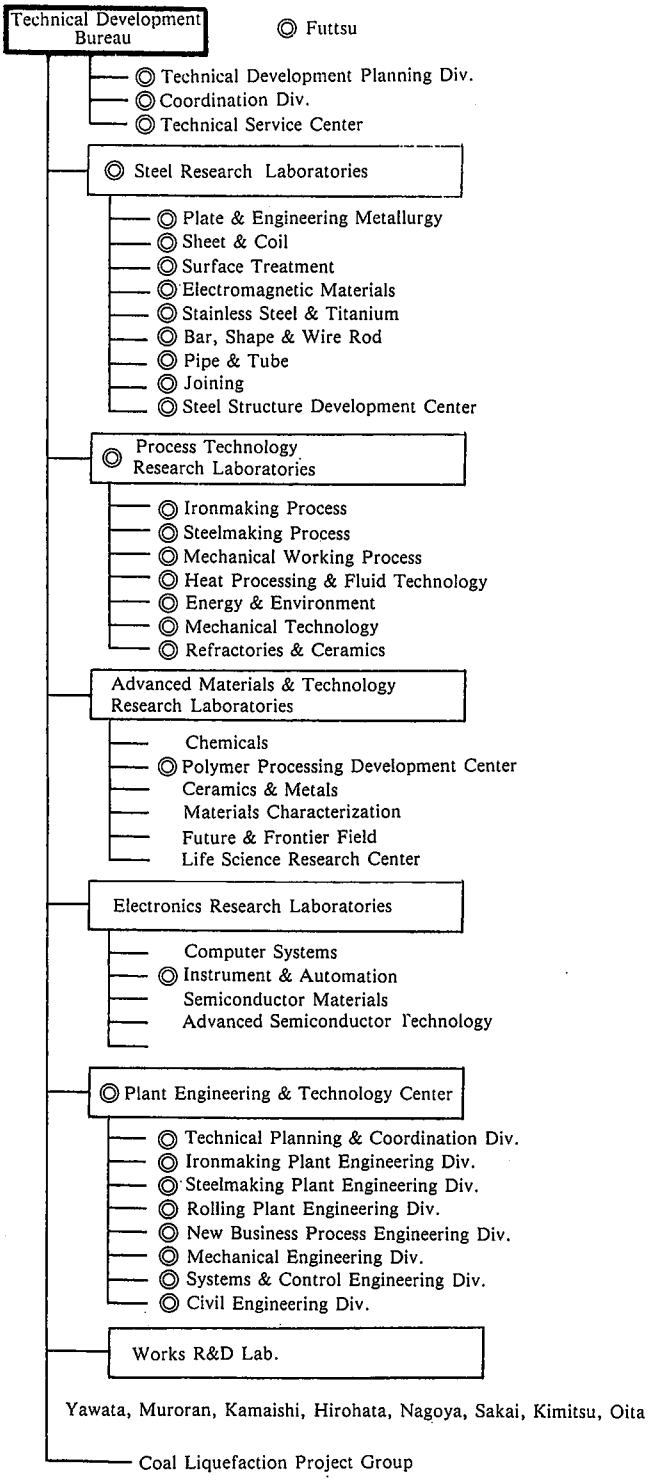


Fig. 4 Organization of Technical Development Bureau

(3) To organize research laboratories by product or process each with specific development goals, and to reinforce these specialized research laboratories with a central elementary research organ.

(4) To install the following new research organs in keeping with the needs of the times:
"Steel Structure Development Center": Conducts research on

steel utilization technology, structural design and construction technology, mainly in the fields of construction and civil engineering, in order to increase the added value and the high-degree utilization of steel.

"Energy & Environment": Conducts research on energy conversion and utilization systems with high social needs and on technology addressing problems of the global environment.

"Mechanical Technology": Conducts research on application technologies for process innovation, factory automation, production system amelioration, etc., on the basis of elementary mechanical technology.

"Polymer Processing Development Center": Conducts research and development from chemical materials through intermediate products to finished products in response to the expansion of plastics and composites business within the Nippon Steel group.

"Life Science Research Center": Conducts research mainly on the relationship of biotechnology, an area expected to grow into a key technology in the future, with humans.

The above four research laboratories, the Plant Engineering & Technology Center as an engineering division, and the R&D Labs. located at nine steelworks were established as working units. The Technical Service (TS) Center, Technical Development Planning Div., and Coordination Div. were installed to support the above laboratories. The new Technical Development Bureau was inaugurated with a total staff size of about 2,700.

3. Facilities

The primary objective of the Research & Engineering Center is the "creation of new corporate culture". The purposes of constructing the facilities are described below.

3.1 Basic concept in the "creation of new corporate culture"

The Research & Engineering Center aims at fusing production process development with product development with technology development as an axis, and thus opening up the way to product realization as soon as possible. The greatest point in this process is mutual stimulation of intellectual quest through functional interchange between researchers in different fields and between researchers and engineers.

Specific points in the construction of facilities were established according to the basic concept of "creation of a space stimulating intelligence and creativity befitting a seat of thinking" (see **Fig. 5**).

Fig. 6 shows the zoning and conceptual description of individual facilities at the center.

3.2 General design of construction

(1) Grand design to promote interchange between researchers in different fields

To promote interchange between researchers in different fields and to capitalize on research results in early practical applications, an inscribed-circle functional zoning method was adopted as a grand design scheme that assures the most efficient flow of people and information through the integration of many facilities of different functions under an integrated R,D&E (research, development, and engineering) system.

The key points of the grand design are as follows:

- A central plaza or court to promote interchange between researchers in different fields
- Buildings located around the central court

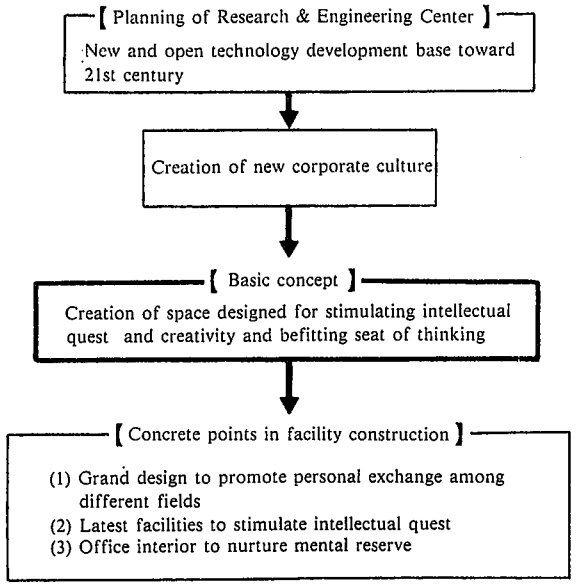


Fig. 5 Basic concepts of facility construction

- A central axis running through the central court as if suggesting the functional orientation of the zoned complex
- Green belts that surround and demark and complex

A color gradation technique was introduced to visually symbolize the orientation of buildings in the grand design. The light gray color of the general administration zone building demonstrates a bright presence against the green vegetation. The research, engineering, and other zones are gradually differentiated in color along the central axis. This color scheme is employed to evoke a sense of harmony with space, alleviate the oppressive feeling often associated with large-scale facilities, and to reproduce a delicate, human-oriented atmosphere (see **Fig. 7**).

(2) Advanced facilities for stimulating intellectual quest

A community space is provided at the center of each facility, and experimental and research laboratories are arranged on both

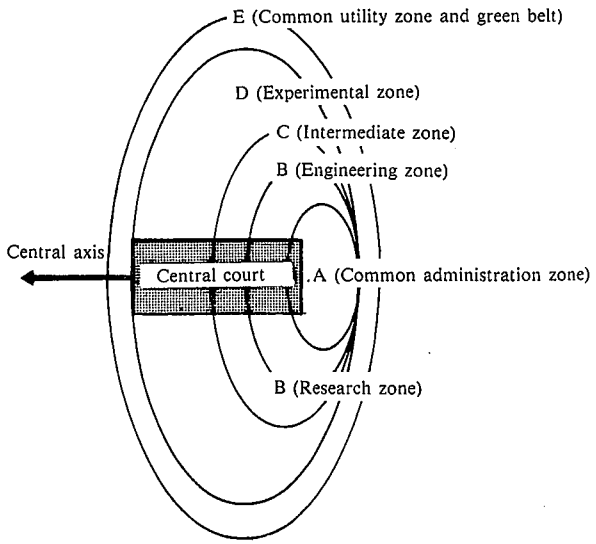
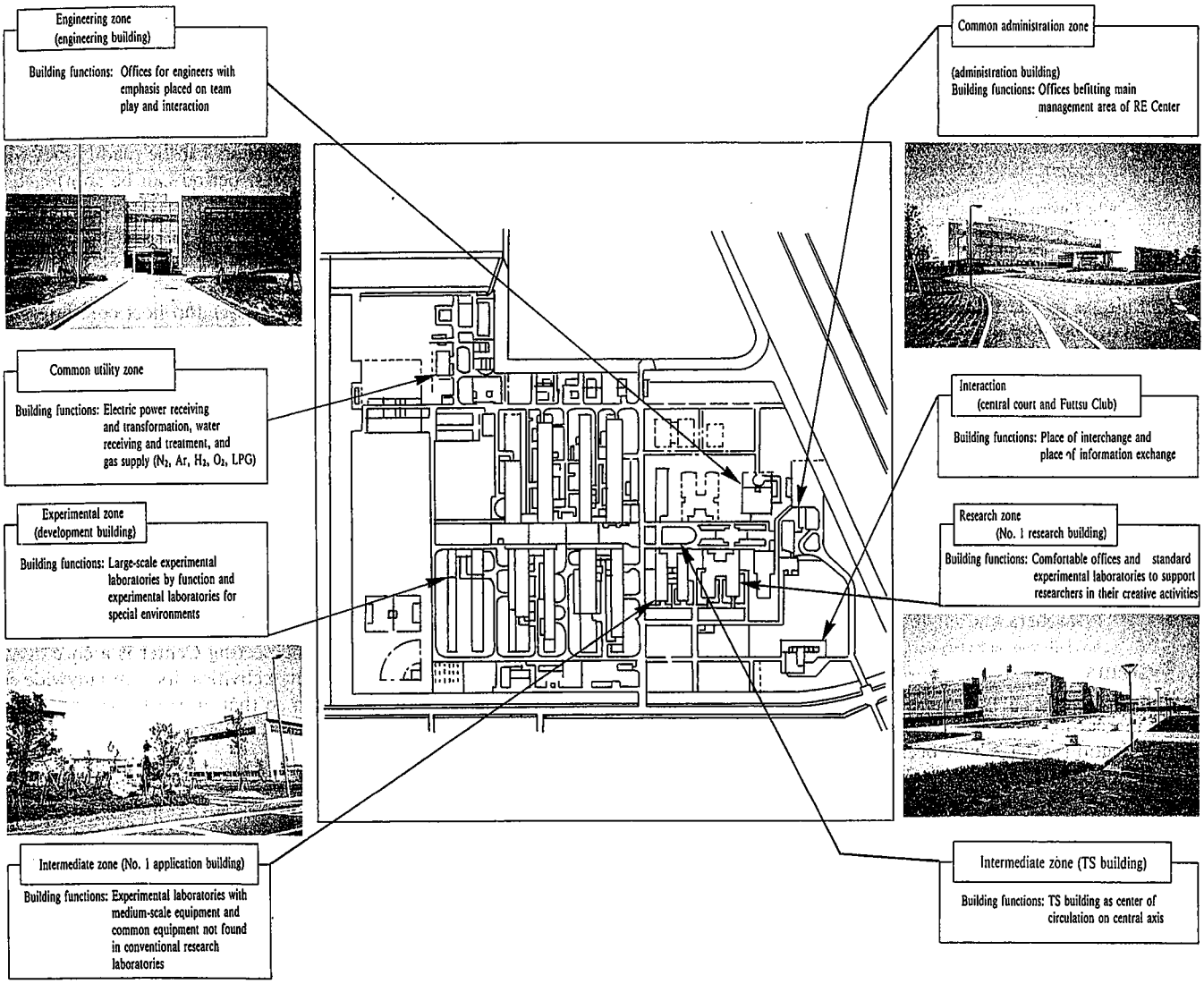


Fig. 7 Layout standard and overall color plan of Research & Engineering Center



Outline of facilities

1. Site area: 700,970.21 m^2, 2. Legal building coverage ratio: 60% Legal floor space ratio: 200%

3. Building area and total floor area

Building name	Building area (m^2)	Total floor space (m^2)	Building name	Building area (m^2)	Total floor space (m^2)
① Administration building	2,501	5,627	⑥ Special development building	4,165	4,164
② Engineering building	2,931	8,406	⑦ TS building	2,015	2,963
③ No. 1 research building	4,753	14,212	⑧ Futtsu Club	1,160	975
④ No. 1 application building	4,374	12,150	⑨ Others	5,237	5,834
⑤ Development building	45,364	46,335			
			Total	72,500 [10.3%]	100,668 (14.4%)

[ ]: Building coverage ratio, ( ): Floor space ratio

Fig. 6 Zones and concepts of facilities

sides of the space. This space design is aimed at promoting intellectual quest, and rational, creative activities. Also, community spaces are provided between individual facilities so that researchers and engineers may stop over there and have discussions on matters of mutual interest.

The utility facilities of high functionality and versatility and large-span experimental facilities, are all for the flexible conversion of research results into viable processes and products. Advanced planning techniques are incorporated to facilitate information exchange and communications and to support a series of creative activities from meeting with each other to translating the results of intellectual efforts into commercial processes and products.

(3) Offices emphasizing amenity

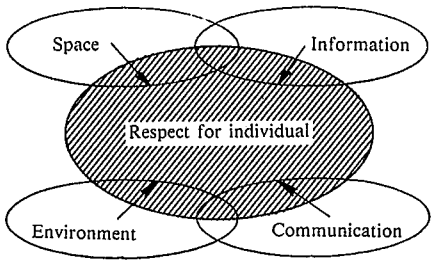


Fig. 8 Concepts of comfort and creativity in office

Techniques to stimulate novel ideas were added to the conventional office building method, as shown in **Fig. 8**. Apart from the conventional hardware, environmental color design is introduced to appeal to the personnel working in the space.

The spatial characteristics of the facilities are clarified by zone, area and element, and environmental colors are selected to make the most of the space functions while taking into account the psychological effects of specific colors to the researchers and engineers. The environmental color design technique is applied not only to building interiors, furniture and markings, but also to blinds, lighting fixtures, and even to such elements as work suits and helmets. Offices are thus designed to appeal to the human nature of researchers and engineers.

4. Systems

Computerization in research, development, and everyday task is ever increasing in sophistication and scope. Information and communication systems have been undergoing rapid innovation. They must be flexible enough to keep up with such changes. The Research & Engineering Center built comprehensive intelligent laboratory offices by introducing the most up-to-date information and communication systems with the aim of promoting advanced research and engineering and implementing related tasks. **Fig. 9** shows the system concept.

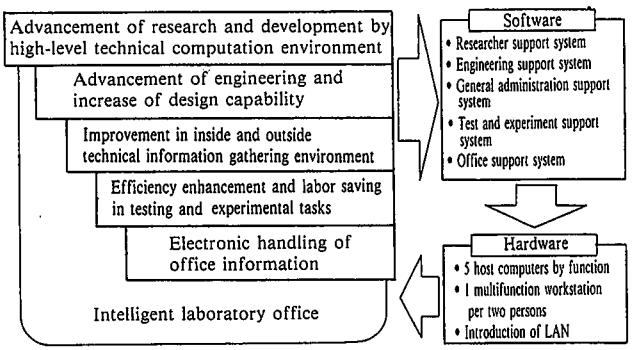


Fig. 9 Concepts of systems

4.1 Concept and objectives of systems

According to the founding concept of the Research & Engineering Center, the information and communication systems were installed with the following objectives:

(1) To reinforce research and development capability and plant engineering technology

The information system is integrated so that necessary information can be timely obtained to assure the continuity of thinking. Computerized experiments and simulation can be efficiently carried through the positive use of computers and work stations.

(2) To drastically increase research and engineering tasks

Requests for office work, business trips, purchases, and other tasks are computerized to increase efficiency.

(3) To enhance the efficiency of testing tasks

Testing requests from researchers can be readily met with a small crew strength, and the test period can be shortened.

4.2 System structure

System construction at this new site was carried out with infrastructure building as one of the main considerations.

(1) Researcher support system

Engineering workstations (EWSs) and host computers were augmented, and a supercomputer was introduced, so that small-scale to large-scale technical calculations could be smoothly executed. Support tools are available to researchers so that they can build data bases of material properties, test results, and other data by themselves.

(2) Engineering support system

A technical information system was developed in which vast volumes of documents like plant plans and technical studies could be filed on optical disks and registered information could be searched for through a multifunction workstation. Drafting and process computer software programming capabilities were augmented, and engineering control system functions were expanded. Since the Research & Engineering Center is a core division for in-house plant engineering activities, its companywide service functions were improved so that all steelworks have access to its estimating systems and data bases.

(3) Technical information system

Access to various data bases was systematically improved so that latest information could be rapidly collected through multifunction workstations from inside and outside the company. Users can search a book data base for the books they want to read from their office, and can loan and return books through dedicated terminals.

(4) Test and experimental system

Research-associated tests are concentralized at the Technical Service (TS) Center. A series of tasks from test application through implementation to reporting, which was manually performed in the past, is computerized now. Tests can be conducted efficiently and rapidly by timely status updating. Test data are processed by a laboratory automation (LA) system and transferred to researchers through computers. Researchers thus can start analyzing the test data without the need for manual data entry. This increases the speed of research tasks.

(5) Office support system

Office jobs, such as the preparation of documents comprising texts and graphics, electronic mail, conference room reservation, electronic bulletin board, and electronic telephone directory, are integrated in multifunction workstations.

(6) Common task system

Basic tasks, such as accounting, purchasing, and personnel administration, were newly organized and improved on the whole. Researchers and engineers can now apply for business trips and sundry purchases through their multifunction workstations.

4.3 Features of systems

The Research & Engineering Center built a large-scale distributed system network employing the local area network (LAN) technology (see **Fig. 10**).

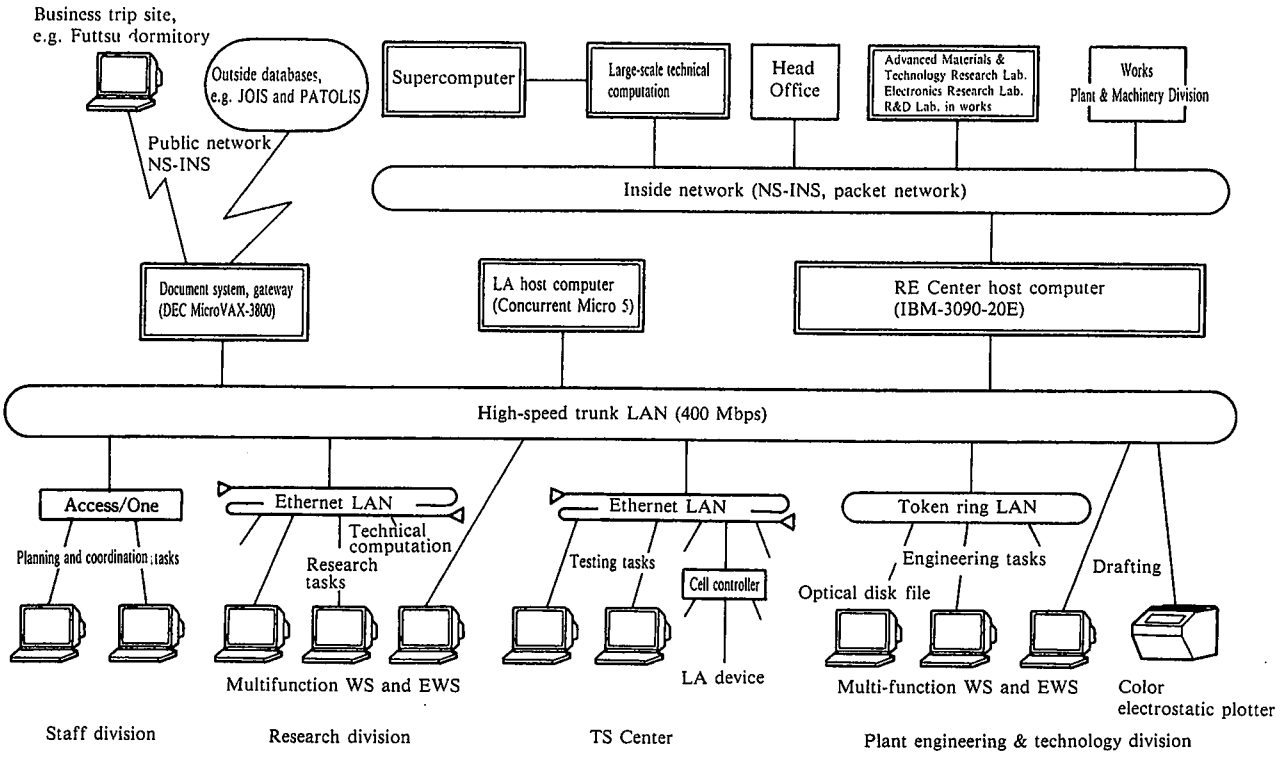


Fig. 10 System configuration

(1) Workstations

Researchers and engineers utilize the large-scale distributed system in all phases of their work. Conventional systems required various terminals to perform specific functions. In the new system, workstations that can perform multiple functions of conventional terminals are installed on the desks at a rate of one unit per two persons. Each user can carry out all the related tasks efficiently and continuously on a single workstation, so that he can engage himself in his creative activity without interruptions in the thinking process. As the users must selectively use multiple computers and many types of systems, they are aided by an original system that supports the start of individual functions by a menu and automation.

(2) Networks

Many workstations are scattered over the Research & Engineering Center compound, whereas host computers are at Kimitsu Works from the standpoint of operation efficiency. Buildings are linked by a high-speed optical fiber cable trunk LAN. The trunk LAN optical fiber cable to the adjacent Kimitsu Works is installed in combination with the electric power transmission submarine cable from the Kimitsu Works to the Futtsu area. Within each building, workstations are connected by three types of floor LANs according to their characteristics and operational optimization. The Research & Engineering Center is linked with all the other areas of Nippon Steel by a companywide network, so that it has access to large-scale technical calculation computers and data bases at the head office, and steelworks, likewise, has access to its systems.

(3) Building design

Offices have free access floors so that workstations can be flexibly installed and moved. Each floor is provided with a communications equipment room, where LAN cables are collected and connected with the trunk line LAN. Indirect lighting with louvers and the like is installed in offices to prevent reflection on the screens of workstations and secure a less fatiguing work environment.

The new large-scale distributed system network places emphasis on the infrastructure to support research and engineering activities. The infrastructure should prove a very effective means of operational support by the use of latest tools. Techniques to master computers in their maturing stages will be combined with numerical analysis methods to match such tools, culminating in the creation of new technologies.

5. Fundamental Research Management

The definition of "fundamental research" is not unique but varies depending on the way of thinking. Corporate R&D systems and organizations relative to fundamental research differ from company to company, and from time to time, too.

The R&D setup of Nippon Steel's Technical Development Bureau, which started anew last year, has no so-called "fundamental research laboratories". At Nippon Steel, fundamental research divisions are not necessarily consolidated into a single institute. Instead, at each laboratory organized according to the technological domain, researches on fundamental technologies are conducted through the evolution, accumulation, and innovation of specialized core technologies in accordance with the characteristics of the domain. Researches on fundamental technologies are taken up as autonomous R&D schemes as against consigned R&D schemes, with the Technical Development Bureau assuming responsibility for target setting and theme designation.

Nippon Steel has been making sustained effort for business

diversification, and currently operates in three major business fields, namely, steel production, engineering, and new businesses.

Product realization technologies combined with production process technologies in these three business fields require conceptual revolution as well as technological innovation in response to today's market demands, such as price reduction, energy conservation, design flexibility, multiple adaptability, and recyclability. To meet these requirements in the most efficient way, the technologies and ideas created in the new and challenging business fields are transformed through technological innovation in the steel production field, and, on the other hand, the technologies accumulated in the steel production field are utilized to attain state-of-the-art technologies that would become core technologies for the 21st century in the new business fields.

Technologies that are likely to become core technologies are defined as "generic technologies: fundamental technologies for creating a group of new products". It is of prime importance that fundamental technologies reinforced or newly developed be evolved into generic technologies. Deepening fundamental technologies would be very helpful in evaluating problems scientifically and quantitatively, which used to be assessed only qualitatively, thereby promoting inter-and trans-disciplinary information exchanges and incubating a new way of thinking.

As for examples of fundamental technologies, the Steel Research Laboratories deal with microstructure control, high temperature properties, deformation and fracture, formability, and corrosion and surface treatment; and the Advanced Materials and Technologies Laboratories address computational science, characterization, surface and interface control, and biological information transmission control.

In the pursuit of fundamental technologies, group work is imperative. It is important to tackle different fields and interdisciplinary domains through positive exchanges with diverse ideas and cultures. Networks with universities, national laboratories, and other bodies outside the company are being actively built with the aim of keeping our organization wide open to the outside society.

6. Challenge at Product Development

Technology development to translate the potentials of iron into concrete products and product development to satisfy diverse customer needs or to deliver seeds of business to customers as materials or utilization and processing technologies are outlined below.

6.1 Themes of product development

Product development may be likened to a process in which a theme of technology development is discovered in the market formation and growth, and a need or seed is returned to the mar-

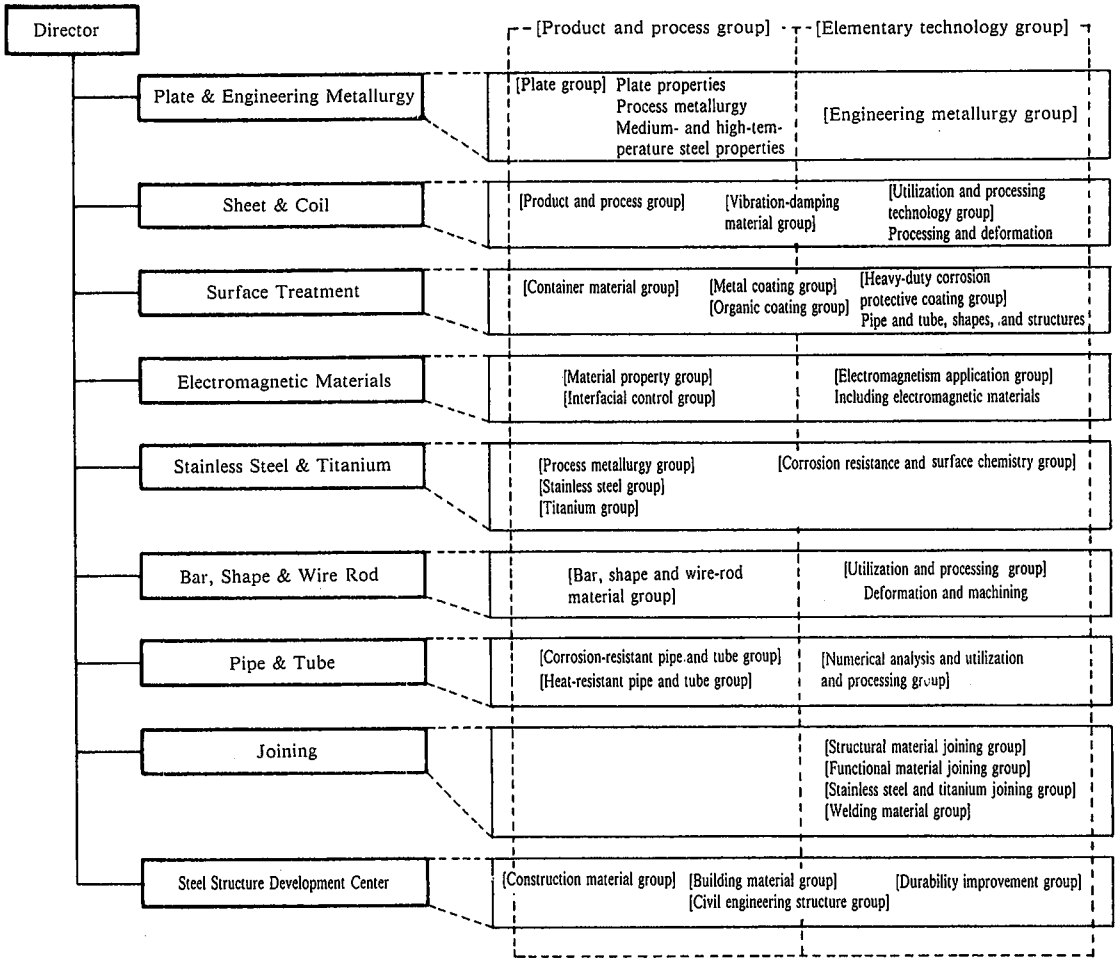


Fig. 11 Functions and organization of Steel Research Laboratories

ket as a material or processing and utilization technology. For example, automobiles must be reduced in weight and improved in durability and energy conversion efficiency, and products must be developed for energy development and transport, as demanded by the problems of energy and resources availability, and the global environment. The social capital problem calls for high-rise buildings and high-speed transit systems. Vibration-damping steel and appliance-oriented products are developed to meet the trend toward increasing comfort in everyday life. It is equally important to develop the new and ultimate functions of steel products and create new markets for them. Still another task is to utilize the material technologies cultivated in product development in new process development.

Fig. 11 shows the organization of the Steel Research Laboratories, a core research institute for product development. About 200 researchers are assigned among seven product research laboratories, one elementary technology research laboratory, and one research and development center. The product research laboratories take charge of product development in their respective fields, and also have the functions of developing elementary technologies common to their fields.

In product development, it is important to catch needs and ascertain market technology trends. To this end, information is acquired from customers through joint studies with them. To carry out development work appropriately and rapidly, cooperation is ensured not only within the Research & Engineering Center, but also with the R&D Labs. and related technical divisions. A project management system is also aimed at for more flexible response.

Deepening of basic technology is key to the creation of original technology. Cooperation is promoted also with universities as well as national and public research institutes.

How product development is carried out at Nippon Steel has been outlined above. Nippon Steel is expanding research and development into nonferrous fields as well.

7. Challenge at Process Research and Development

"Establishment of iron and steel production processes to build social life with rich humanity and to bring about corporate prosperity in harmony with the global environment" is the mission of the Process Technology Research Laboratories, as outlined below.

7.1 Goals of process development

Changes in the social and economical situations surrounding the steel industry in recent years have intensified market competition in Japan and abroad, have brought about the problems of the global environment and labor, and have increased the need for the development of new products and innovative processes. In keeping with this situation, the Process Technology Research Laboratories aims at research and development on the following iron and steel production processes:

(1) Processes to achieve resources and energy savings, minimize the generation of harmful wastes, and contribute to the improvement of the global environment,
(2) Processes to meet diverse needs, and deliver products in a short time,
(3) Processes to best exploit the functions of, and create new markets for steel products,
(4) Processes to create comfortable workplaces by making the most of leading-edge technologies,
(5) Processes to attain all the above goals at the lowest cost.

7.2 System for challenge at process development

To accomplish those processes, mentioned above, the Process Technology Research Laboratories, a core research institute of process research and development, carries out research and development under the organization shown in **Fig. 12**. About 160 researchers are assigned among five process research laboratories and two elementary technology research laboratories. They comprise a powerful research organization while playing the roles of the warp and weft in woven cloth. Through the best utilization of technologies cultivated in the iron and steel production

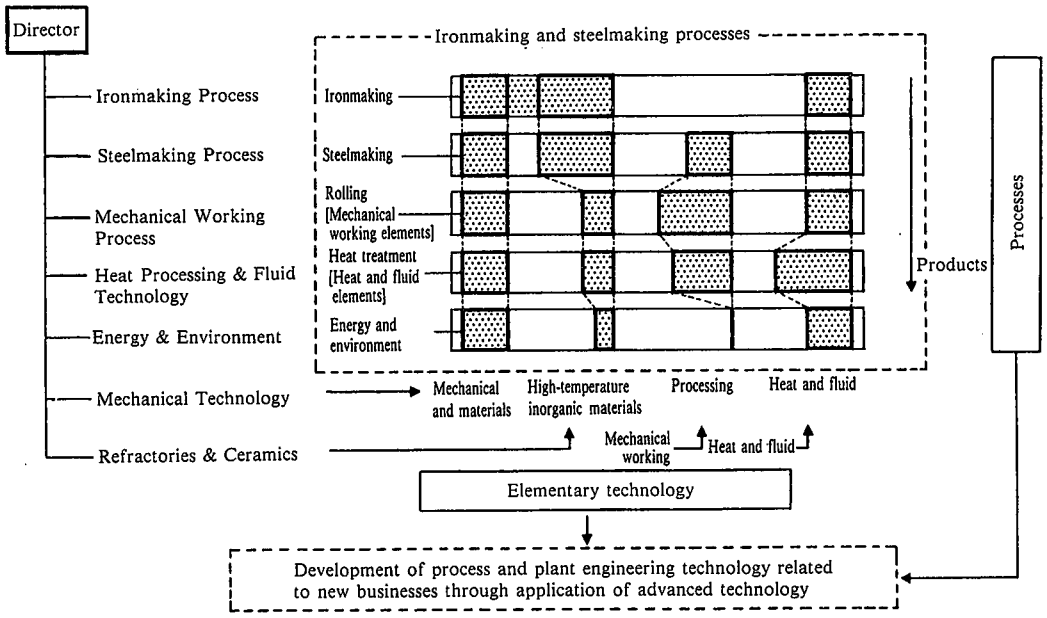


Fig. 12 Research and development system of Process Technology Research Laboratories

processes, they cooperate in the development of process and plant engineering technologies in advanced material and other new fields.

To adequately meet the needs for product development and commercialize the results of research and development as early as possible, the Process Technology Research Laboratories maintains close cooperation with the other research laboratories at the Research & Engineering Center, and has cooperative relations with other divisions concerned within the company.

It endeavors to reinforce basic technologies and introduce advanced technologies in cooperation with universities and other research organizations near the Futtsu area.

8. Challenge at Engineering

8.1 History of Plant Engineering & Technology Center

In 1972, the Plant Engineering & Technology Center was established in Kitakyushu City with the aim of innovating plant engineering technology on a companywide basis and implementing iron- and steel-making plant engineering projects at Nippon Steel and outside. Since then, the center has been engaged in the construction of large-scale iron- and steel-making plants at Nippon Steel as well as ILVA of Italy, USIMINAS of Brazil, Pohang of Korea, and Baoshan of China. More recently, the center has built cold strip mills and coating lines, as represented by I/N Tek and I/N Kote of the United States. With about 360 engineers, the center takes charge of plant engineering not only in the iron and steel production field at Nippon Steel and outside, but also in new business fields like electronics and communications. In these activities, the center operates as a component of the Technical Development Bureau that was inaugurated for the primary objective of "performing research, development, and commercialization engineering on an integrated basis".

8.2 Implementation of innovative engineering

"Engineering" may be defined as "accomplishment of an optimum plant to meet a given objective through the application of the latest technology and knowledge". As much intellectual resources as possible must be applied to solve specific problems. Among the merits of this organization system are early commercialization of research and development results, solicitation of research and development themes from the engineering division, professional and theoretical clarification of process dynamics and field themes, and optimum plant design based on latest research and development results.

8.3 Challenge at development

Industrial activities friendly to the environment and people are demanded in society, as exemplified by the Earth Summit held in 1992 in Rio de Janeiro, Brazil. Engineering is always called on to solve new problems in this area, and it is essential that we should not fail to apply new and advanced technologies to engineering projects. For this reason, we address the following themes with priority:

(1) Realization of next-generation steel-making processes
(2) Improvement of plant characteristics
(3) Labor saving and improvement in worker comfort in production field
(4) Maximum application of seed technologies

8.4 Base for transmission of plant engineering technical information

Implementation of engineering requires knowledge about many items, such as processes, elementary technologies and engineering techniques. Much knowledge is therefore accumulated in the course of engineering. As a core of plant engineering technology at Nippon Steel, the Plant Engineering & Technology Center consolidates, accumulates, evaluates and directs the plant engineering technologies of the entire company, and positively participates in the activities of related academic societies.

The Plant Engineering & Technology Center is characteristic in that it incorporates the overall capability of an integrated research and development and engineering organization. It can provide optimum and efficient engineering by utilizing research and development results and new technologies. It can provide high-quality engineering, assuring a high return on investment realizable partly through the shortening of the construction period.

With the newly completed Research and Engineering Center, Nippon Steel has made an important step forward in its untiring effort to realize its unique concept of technical development. The new Center features advanced hardware functions, an environmental coloring scheme and high operation efficiency, altogether aimed at creating reserves in both time availability and human intellectual resources for further technical innovation.

Research activities here may be classified into 1) fundamental research in which the world industry-leading research work will be carried out, 2) product development which will be conducted in the global perspective of market trends in pursuit of the possibilities of iron and steel, and 3) process development which will be focused on the development of manufacturing processed that are friendly with materials, earth's environment, and human being.

The engineering division has a vast asset of accumulated knowledge and experience in plant engineering. In addition, it can utilize the intellectual resources of the research and development division that are readily available to serve the needs of its clients in and outside Nippon Steel.