NEC Integrated Report 2024

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Innovation: R&D and Business Development

Since its founding, NEC has developed a variety of proprietary technologies in the area of ICT to support social infrastructure and mission-critical systems. We believe that a key component to realizing the NEC 2030VISION in a so-called VUCA[1] world is working toward R&D co-creation, expanding open innovation, and venturing into new domains to create businesses that can impact society.

1 VUCA: Volatile, Uncertain, Complex, and Ambiguous

NEC's Technological Capabilities

NEC possesses many of the world's leading technologies in the fields of AI (biometrics, image recognition, and analysis/prescription AI), telecommunications, and security. These technologies are NEC's greatest differentiating factor. As proof of this, we boast one of the world's highest numbers of patents held and papers accepted by leading international academic conferences. In particular, in the field of facial authentication, we have been ranked No. 1 in benchmark testing multiple times[2]. These advanced technological capabilities are key assets that will lead to NEC's future growth.

2 Ranked No. 1 multiple times in facial authentication benchmark testing held by the U.S. National Institute of Standards and Technology (NIST)
https://www.nec.com/en/global/solutions/biometrics/index.html

Note: NIST testing results do not constitute an endorsement by the U.S. government of any particular system, product, service, or company.

Approach to R&D Investment

We allocate approximately 4% of revenue to R&D in order to maintain and improve our R&D capabilities over the medium to long term, independent of any external trends.
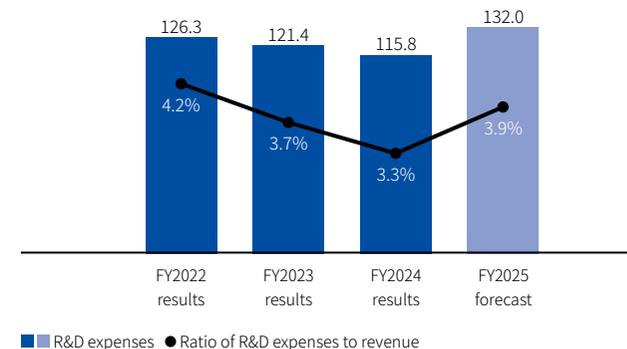
Our R&D efforts are focused on basic research, which creates functions from knowledge, and applied research, which creates customer value from functions.

In basic research, we have defined six core technology areas—Recognition AI, analytical AI, control AI, security, networking, and system platforms—and are working to create new functions and bring about overwhelming innovation in existing functions.

In applied research, we are engaged in efforts to embody functions realized in fundamental research as new value delivered to customers and society.

Ratio of R&D Expenses to Revenue
(Billions of yen)

	FY2022 results	FY2023 results	FY2024 results	FY2025 forecast
R&D expenses	126.3	121.4	115.8	132.0
Ratio of R&D expenses to revenue	4.2%	3.7%	3.3%	3.9%

■ R&D expenses   ● Ratio of R&D expenses to revenue

AI (including biometrics)	• Machine learning: Number of papers accepted by leading international academic conferences[3]: **Ranked 10th in the world** • Video and image processing: Number of papers accepted by leading international academic conferences[4]: **No. 1 in Japan**	🌐 For third-party evaluations of NEC biometric authentication, Please visit the website below. https://www.nec.com/en/global/solutions/biometrics/index.html
Communication	• Optical communication: Acceptance of papers by leading international academic conferences[5] for **46 consecutive years**	
Security	• Receipt of IPSJ Yamashita SIG Research Award for Cyber Security, Computer Security Symposium 2021 (CSS 2021), and **numerous other awards[6] for research papers**	
Patents	• Top 100 Global Innovators global survey of patent activities[7]: **Selected for 13 consecutive years**	• Biometric authentication, video analytics, and analysis/prescription AI: Number of international patent applications[8]: **No. 1 in the world**

3 NeurIPS, ICML, KDD, ECML-PKDD, ICDM   4 CVPR, ICCV, ECCV, ACCV, ICPR   5 Communication: OFC/ECOC
6 Security: ACM, CCS, Eurocrypt, IEEE S&P, etc.   7 Top 100 Global Innovators: https://clarivate.com/top-100-innovators/
8 Number of international patent applications: Cumulative number of applications as of November 2023 (NEC Corporation)

🌐 For the latest on R&D, please see the NEC Innovation Day presentation on the Management Strategy Meeting / Business Briefing section of our website.
https://www.nec.com/en/global/ir/events/pr/others.html

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Converting R&D Results into Social Value

To quickly connect technologies accumulated through R&D to the resolution of social issues and the creation of other new social value, NEC is engaged in the following three approaches.

> 1. Provision of new value leveraging existing businesses
> 2. Utilization of intellectual property to contribute to business
> 3. Creation of new businesses as the next pillars of growth

1. Provision of New Value Leveraging Existing Businesses

To convert cutting-edge technologies into social value, it is important to incorporate them into society as quickly as possible. At NEC, we are making efforts to more quickly reflect customer needs and achieve product commercialization through the establishment of a seamless system of collaboration with the business side from the R&D stage onward.

We are working to quickly provide customers with solutions based on numerous NEC technologies by incorporating them into NEC BluStellar's offering menu. This enables us to make optimal proposals using leading-edge technology to give us a competitive advantage, and also leads to improved profitability through the repeatable provision of services.

In addition, to contribute to the advancement of infrastructure for realizing a safe and secure society, we are working on the development of advanced technologies such as next-generation high-speed, high-capacity telecommunications, quantum cryptography, and integrated networks in space, while discussing and sharing future concepts with the relevant government agencies and companies.
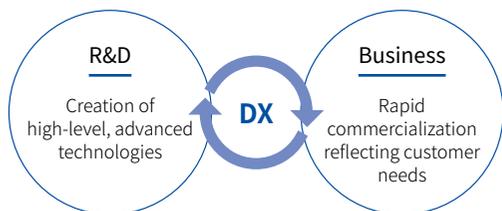
2. Utilization of Intellectual Property to Contribute to Business

Intellectual Property Policy ————————

NEC regards intellectual property (IP) as an important management resource that promotes business competitiveness and stability, as well as co-creation with customers and partners. To realize the NEC 2030VISION, we are contributing to the enhancement of corporate value through building broad utilization of an effective IP portfolio by concentrating resources on IP in Mid-term Management Plan 2025 growth business areas and in technology areas that will create the next pillars of growth.

In recent years, there has been an increase in opportunities for the wide-ranging use of IP in ICT, including AI and biometric authentication. In addition to the conventional uses of IP for business defense and expansion, as well as co-creation with customers and partners, we are working on a fundamental reform of the process involved in the creation, use, and framework for the promotion of IP aimed at increasing revenue through the provision of IP and IP licenses to the extent necessary.

Furthermore, NEC is strategically engaged in standardization activities with the aim of expanding business in growth areas. In particular, in important technological fields such as AI, biometric authentication, and telecommunications, NEC holds important positions such as chairman of the Japanese Industrial Standards Committee, while playing a leading role in standardization activities within and outside Japan.
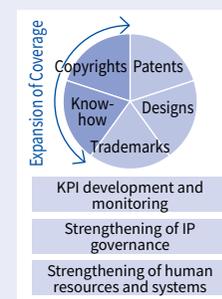
Promotion Framework ————————

To build and utilize our IP portfolio on a global scale, we have appointed IP managers in business units and at Group companies, and established IP centers in North America, Europe, and China. In addition, in terms of the promotion of standardization, we have established an internal collaboration system centered on the Liaison Committee for Company-wide Standardization Activities, which is made up of members selected from across the Group, with the aim of expanding our businesses through standardization.

Specific Plan of Action for the Intellectual Property Management Division

- Build and update IP portfolio to achieve the goals of Mid-term Management Plan 2025, including those in relation to NEC BluStellar
  - Expand coverage of IP portfolio to include industrial know-how and copyrights in addition to patents and designs
  - Expand design and trademark rights that support global brands
  - Promote integration of IP and design (received Distinguished Service Award for Design Management from the Japan Patent Office in fiscal 2024)
- Strengthen use of IP portfolio
  - Support commercialization through external collaborations (NEC X, BIRD INITIATIVE, etc.)
  - Commercialize licensing, establish as stable source of revenue and reinvest it in the creation of social value and IP
- Establish new KPIs to manage and evaluate the creation and utilization of an effective IP portfolio. Monitor cost-effectiveness
- Strengthen global IP governance. Strengthen implementation systems and refine utilization strategies by increasing the number of global specialists, hiring attorneys and accountants, and other measures

Strengthening IP Portfolio and Foundation for Activities / Utilization of IP Portfolio

🌐 For IP-related policies and initiatives, please visit the website below.
https://www.nec.com/en/global/intellectual-property/index.html

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Innovation: R&D and Business Development

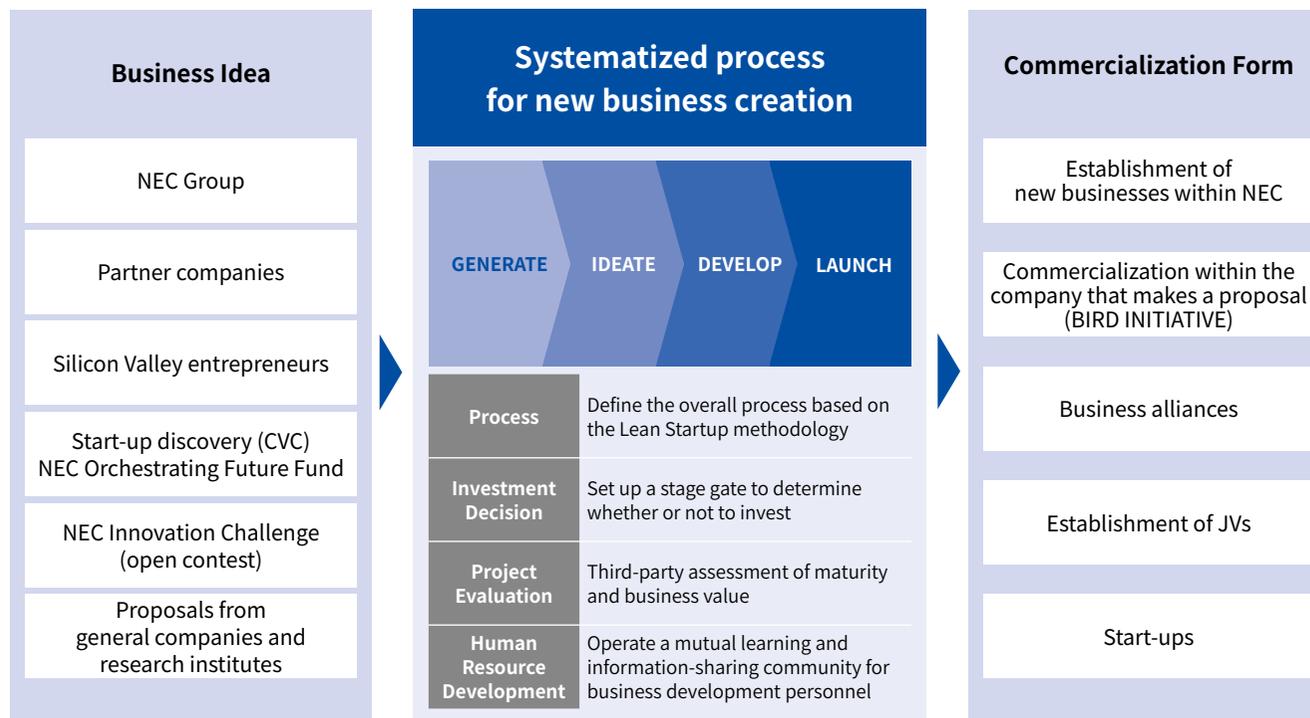## 3. Creation of New Businesses as the Next Pillars of Growth

In the development of new businesses, the NEC Group will use its globally strong technologies in AI-related, healthcare and life science, and carbon neutrality-related fields to promote commercialization through collaboration with leading-edge customers and research institutions, including overseas, and by using the new business development know-how and methods that it has cultivated in recent years. The NEC Group targets the creation of ¥300.0 billion in business value by 2025 and will take on the challenge of creating business value through a variety of co-creation methods.

New Business Creation Management Policy

NEC's new business creation starts by gathering ideas both in-house and from global sources of wisdom, including technology seed-oriented and market-oriented proposals. We will steadily nurture new business while controlling risk, based on the new business creation process that we have systemized over five years of efforts. In addition, we are not limiting ourselves to in-house commercialization, but are also considering a variety of options based on individual characteristics, such as in-house commercialization and the establishment of start-ups and joint ventures (JVs) with external partners.

🌐 For details on initiatives for developing new businesses, please visit the website below (in Japanese only). https://jpn.nec.com/innovation/index.html

NEC Business Innovation Process

Business Idea

- NEC Group
- Partner companies
- Silicon Valley entrepreneurs
- Start-up discovery (CVC) NEC Orchestrating Future Fund
- NEC Innovation Challenge (open contest)
- Proposals from general companies and research institutes

Systematized process for new business creation

GENERATE | IDEATE | DEVELOP | LAUNCH

Process	Define the overall process based on the Lean Startup methodology
Investment Decision	Set up a stage gate to determine whether or not to invest
Project Evaluation	Third-party assessment of maturity and business value
Human Resource Development	Operate a mutual learning and information-sharing community for business development personnel

Commercialization Form

- Establishment of new businesses within NEC
- Commercialization within the company that makes a proposal (BIRD INITIATIVE)
- Business alliances
- Establishment of JVs
- Start-ups

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Examples of New Business Creation Initiatives

Healthcare and Life Science Businesses ⊕

NEC is developing the following businesses based on strengths in AI technologies.

- Electronic medical records and hospital DX
  Supporting hospital management efficiency and improved medical quality through the use of generative AI to create medical documentation, etc.
- Health promotion and medical test service (FonesVisuas)
  Measuring various proteins from a small amount of blood, and visualizing disease risk and health status using AI and big data analytics technologies
- AI drug development
  Developing vaccines utilizing cutting-edge AI technology, spanning the biomedical science and ICT domains, with a focus on personalized cancer vaccines
  (Examples: Personalized cancer vaccines, universal vaccines design that utilizes AI, etc.)

AI Farm Management (Agriculture) ⊕

Using soil moisture data and satellite image data, this system visualizes field conditions necessary for farming, and provides farming advice and harvest control using AI to achieve optimization.

- Kagome Co., Ltd. and NEC established DXAS Agricultural Technology, a company that uses AI to provide farming support for processed tomatoes, in Portugal

Green / Carbon Neutrality-related Business ⊕

Strengthening and expanding resource aggregation businesses that match surplus electricity generated from renewable energy sources in the market and achieve efficiency and optimization
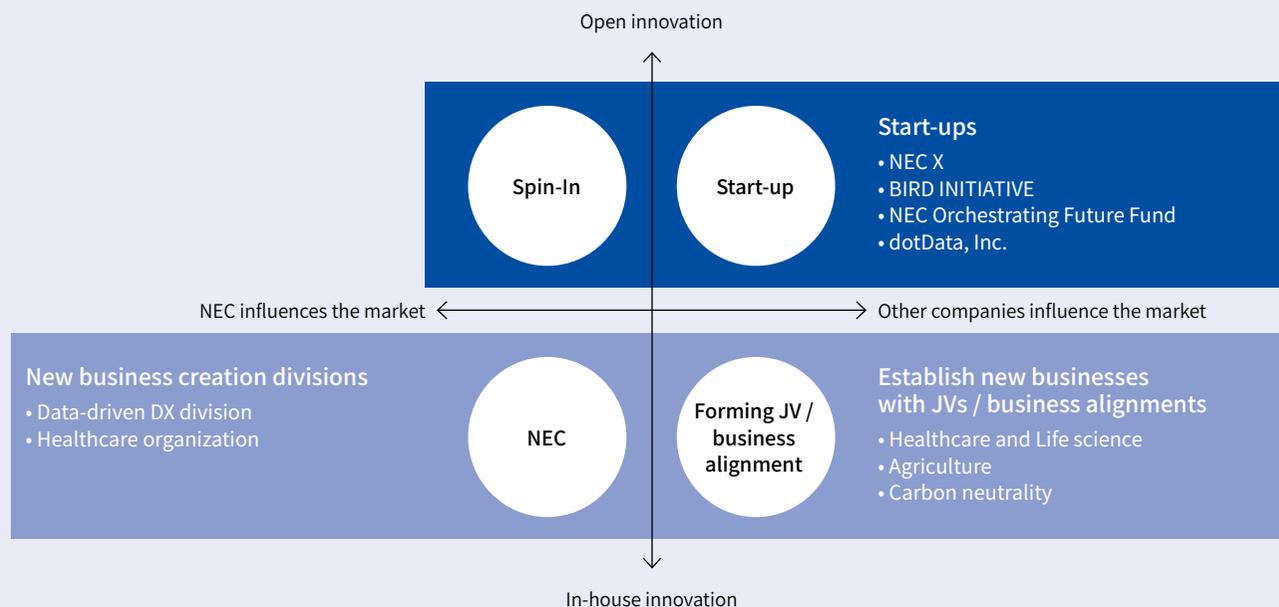
dotData, Inc. ⊕

- dotData was founded and promoted by a leading NEC researcher.
- Using AI technologies, dotData automates data analysis processes that would otherwise take an extremely long time to complete manually, thereby shortening the time required and helping to achieve DX promotion as quickly as possible.
- Completed Series B financing in spring 2022 ($74.6 million in total)

BIRD INITIATIVE, Inc. ⊕

- Seven companies, including NEC, a business company, a financial company, and academia, have invested in this collaborative R&D project.
- BIRD INITIATIVE creates innovation by combining the technologies, assets, and human resources of large corporations with external capital, human resources, and cutting-edge IT, accompanying clients as an innovation partner and providing consistent services, from applied research to business launch.

NEC X, Inc. ⊕

- Established in California to accelerate new business development based on the strength of NEC's R&D in collaboration with the Silicon Valley start-up ecosystem

Open innovation

		Start-ups
Spin-In	Start-up	• NEC X • BIRD INITIATIVE • NEC Orchestrating Future Fund • dotData, Inc.

NEC influences the market ← → Other companies influence the market

| New business creation divisions
• Data-driven DX division
• Healthcare organization | NEC | Forming JV / business alignment | Establish new businesses with JVs / business alignments
• Healthcare and Life science
• Agriculture
• Carbon neutrality |

In-house innovation

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Generative AI Development and Commercialization

In recent years, there has been increasing attention paid to generative AI as an innovative technology. In July 2023, NEC announced its own generative AI, and in December it began commercial deployment as "cotomi." This large language model (LLM), which forms the foundation of generative AI, has world-class Japanese language processing performance, and is unique in that it can be customized to meet individual business needs by having it learn from company-specific data.

Merits of NEC's Generative AI

- **High speed**
  Ingeniously designed and offering high-speed performance, cotomi is also suitable for business system integration

- **High accuracy**
  Advanced learning facilitates highly accurate inferences in a variety of tasks

- **Various delivery formats**
  Utilizing flexible delivery formats, cotomi is able to provide a secure, highly convenient environment

This development was made possible by the utilization of one of Japan's largest supercomputers for AI research, built some time ago, and by the technological capabilities that NEC has inherited and accumulated over half a century of AI research.

For this generative AI to create social value, it must be utilized in actual business and research settings and facilitate improved productivity and other outcomes. We launched an organization comprising generative AI experts, to provide comprehensive customer support on everything from consulting to system construction, and even human resource training. Through seamless collaboration between R&D and business promotion teams, we are accelerating the commercialization and practical application of generative AI research results.

We have also launched a customer program in which we work with companies, universities, and other organizations to come up with helpful ways to incorporate AI while actually using it. At present, we are working with 15 companies and organizations to build LLMs specialized for each industry and

business, which learns from their business data and knowledge bases, to pursue improved productivity and other actual benefits of implementation. As a result of these efforts, there are now cases of individual companies and local governments utilizing and demonstrating this technology.

We have also commenced sales of an electronic medical record system incorporating functions that use generative AI to assist in the creation of medical records and documents.

🌐 Please visit the website below for examples of NEC generative AI cotomi utilization (in Japanese only).
https://jpn.nec.com/LLM/index.html#anc-nav06

R&D	Business	Customers
Technological research → Prototypes → Business planning and solutions	Commercialization	

NEC R&D Technologies

- Advanced AI
- Intelligent platforms
- Ultra-high-capacity, high-speed network
- Optimization
- Simulations
- Sensing

NEC BluStellar

- Strategic consulting
- Offering common infrastructure
- Operation and maintenance
- Service delivery

Value provided to customers

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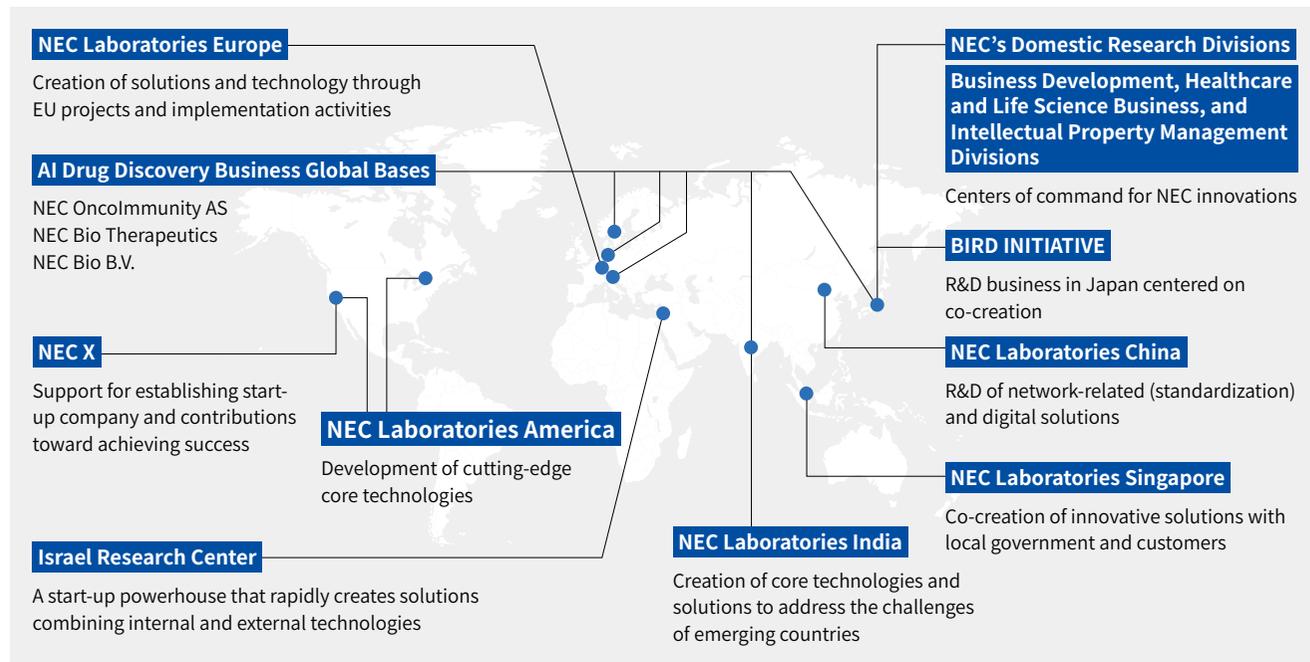
Innovation: R&D and Business Development

Developing People and Environments to Drive Innovation

NEC believes that the power of human resources is essential to creating innovation. We attract excellent human resources from all over the world, and approximately 40% of our researchers are global specialists.

In addition to researchers, specialist human resources in new business development and IP are critical for the provision and implementation of technological innovations as a social value. We are working to expand our pool of specialized talent in each area through external recruitment and internal training, while also promoting stronger collaborations between each function. We are also working to improve the R&D environment so that the talented human resources we have gathered can fully demonstrate their abilities. As an example, NEC has the largest supercomputer for AI research of any company in Japan, which has enabled us to quickly develop an LLM that serves as the foundation for generative AI offering excellent Japanese language processing capabilities.

Leveraging Global Strengths to Increase R&D and Business Development Opportunities

NEC Laboratories Europe
Creation of solutions and technology through EU projects and implementation activities

AI Drug Discovery Business Global Bases
NEC OncoImmunity AS
NEC Bio Therapeutics
NEC Bio B.V.

NEC X
Support for establishing start-up company and contributions toward achieving success

NEC Laboratories America
Development of cutting-edge core technologies

Israel Research Center
A start-up powerhouse that rapidly creates solutions combining internal and external technologies

NEC Laboratories India
Creation of core technologies and solutions to address the challenges of emerging countries

NEC's Domestic Research Divisions
Business Development, Healthcare and Life Science Business, and Intellectual Property Management Divisions
Centers of command for NEC innovations

BIRD INITIATIVE
R&D business in Japan centered on co-creation

NEC Laboratories China
R&D of network-related (standardization) and digital solutions

NEC Laboratories Singapore
Co-creation of innovative solutions with local government and customers

R&D Division	Corporate Business Development Division	Intellectual Property Management Division
Researcher	**Business Accelerator**	**IP Specialists**
Global human resources 40% (top-class researchers hired at seven sites)	Strengthen domain experts (experience in external business 40%)	Strengthen global recruiting of attorneys and patent agents
External human resource development through industry–academia collaborations (collaborations with overseas bases, doctoral scholarships*, etc.)	Business leadership human resource development (promote new JVs and venture secondments)	Creation and strengthening of Litigation and Counsel department (2022–)

* NEC and the Tokyo Institute of Technology established the NEC R&D Doctor's Pass system to support doctoral students.
https://www.nec.com/en/global/rd/lablife/system/doctors-p.html