# 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* world is working toward R&D co-creation, expanding open innovation, and venturing into new domains to create businesses that can impact society.

* VUCA: Volatile, Uncertain, Complex, and Ambiguous

## NEC's Technological Capabilities

### Technological Fields

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 held by the U.S. National Institute of Standards and Technology (NIST) five consecutive times, and our brand is the most recognizable in the world when it comes to in biometric authentication.

These advanced technological capabilities are key assets that will lead to NEC's future growth. A crucial factor in transforming these long-cultivated technologies into social value is how quickly we can implement them in greater society. As an example, NEC is working to generate business by offering a menu of solutions based on its many technologies in the form of the NEC Digital Platform, which not only enables us to promptly provide value to customers but also leads to improved profitability by encouraging repeat use of this common platform.

Note: NIST testing results do not constitute an endorsement by the U.S. government of any particular system, product, service, or company.
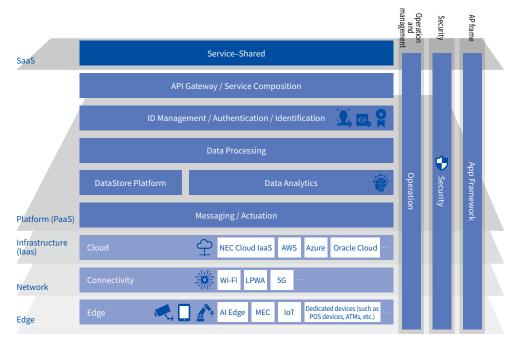
| | | |
|---|---|---|
| AI (including biometrics) | • Machine learning: Number of papers accepted by leading international academic conferences[1]: 8th in the world<br>• Video and image processing: Number of papers accepted by leading international academic conferences[2]: No. 1 in Japan | • Facial recognition: No. 1 in the world<br>• Iris recognition: No. 1 in the world<br>• Fingerprint recognition: No. 1 in the world<br>• NEC's biometric solutions (out of 62 global companies): No. 1<br>• Biometric authentication: The world's most recognizable |
| Communication[3] | • Optical communication: Acceptance of papers by leading international academic conferences for 45 consecutive years | |
| Security[4] | • Receipt of IPSJ Yamashita SIG Research Award for Cyber Security, CSS2021, and numerous other awards for research papers | |
| Patents | • Top 100 Global Innovators global survey of patent activities[5]: Selected for 11 consecutive years | • Biometric authentication, video analytics, and analysis/prescription AI: Number of international patent applications[6]: No. 1 in the world |

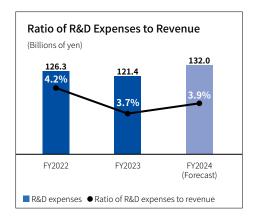1 NeurIPS, ICML, KDD, ECML-PKDD, ICDM
2 CVPR, ICCV, ECCV, ACCV, ICPR
3 Communication: OFC/ECOC
4 Security: ACM, CCS, Eurocrypt, IEEE S&P, etc.
5 Top 100 Global Innovators: https://clarivate.com/top-100-innovators/
6 Number of international patent applications: Cumulative number of applications as of November 2022 (NEC Corporation)

Innovation: R&D and Business Development

## 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.

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

| | 126.3 | 121.4 | 132.0 |
|---|---|---|---|
| | 4.2% | 3.7% | 3.9% |
| | FY2022 | FY2023 | FY2024 (Forecast) |

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

## NEC's R&D Management

A key aspect of R&D is how to translate its results into the creation of products, services, and businesses in a timely, appropriate, and efficient manner. NEC has introduced agile development, whereby it creates value by accurately identifying market issues and quickly providing products and services that meet associated needs. Given that time is a source of competitive advantage, implementing technology at the right time can be a major differentiating factor. NEC takes two approaches to technological development: needs oriented and seeds oriented. The needs-oriented approach is based on requests from business units and aims for more reliable contributions to earnings and agile commercialization of products. In some cases, we base our development on external technologies. In such cases,

we respond to needs by utilizing the advanced technological testing of our researchers, rather than limiting ourselves to proprietary technologies. The seeds-oriented approach, on the other hand, aims to achieve commercialization based on technological proposals from top researchers and seeks early commercialization through a two-way approach. The research budget is divided between basic research and applied research. Basic research is left to the discretion of researchers, with challenging papers and patents used as KPIs, as has been the case to date. Applied research is conducted in a way that allows us to make necessary improvements as needed by monitoring the results of contributions based on ROI/ROIC.

## Intellectual Property Strategy

### 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 business partners. To realize the NEC 2030VISION, we are building and widely utilizing an effective IP network by concentrating

our IP resources on growth areas such as core DX, Digital Government Digital Finance, and global 5G, as well as on technological fields that will generate future growth businesses. We are

also working to increase the market presence of our IP by strategically engaging in activities related to standardization, ecosystems, and thought leadership.

---

**Specific Plan of Action**

- Increase the percentage of patent applications and patents held in growth business areas and continue to strengthen the patent portfolio
- Strengthen and utilize not only patent rights and know-how but also design and trademark rights that support global brands
- Support the commercialization of businesses through external collaborations that make use of proprietary technologies
- Establish a new IP division to promote comprehensive use of IP, while strengthening execution frameworks and utilization strategies

---

## Promotion Framework

To build and utilize our patent portfolio on a global scale, we have appointed IP managers in business units and at Group companies and have established IP centers in North America, Europe, and China. In addition, we are developing an IP support system geared toward the execution of R&D businesses engaged in value co-creation with external business partners and the creation of new businesses. Furthermore, we are cooperating with relevant divisions to ensure that NEC's brand, product design, and other proprietary rights are protected.

In fiscal 2023, we established a new organization to handle high-level IP-related legal work and formulated an overall policy to strengthen the Company-wide utilization and monetization of IP as well as enhance the mitigation of associated risks. We are adding to our diverse talent pool with human resources such as qualified lawyers and non-Japanese personnel to help drive forward these activities.

**Intellectual Property (IP) Management Division: Strengthening NEC's IP Capability**

**IP Strategy Implementation Framework**

Intellectual Property Management Division

- Collaboration system with IP managers in business units, non-business units, and Group companies
- Intellectual property centers (North America, Europe, and China)

NEC Patent Service, Ltd.

↓

Business units / Non-business units

NEC Group companies in Japan and abroad

↓

**Building an effective global patent portfolio and Promoting new co-creation**

Innovation: R&D and Business Development

## Accelerating Commercialization through Various Management Systems

### ▌Processes Aimed at Commercialization

To resolve social issues and realize the NEC 2030VISION, it is important that we transform the technologies—our strength—into value, and link said value to the expansion of existing businesses and the creation of new ones. To this end, it is essential that we establish a scheme for market intelligence, development of technology, development of business, and acceptance within society. NEC is taking on the challenge of R&D co-creation, expanding open innovation, and venturing into new domains to create businesses that can impact society, while working to implement the technologies that are its strength in greater society.
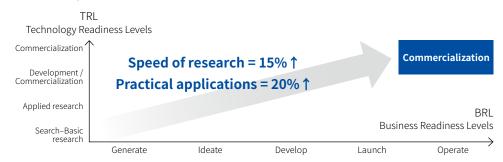
### ▌Process Management with BRL / TRL

To enable prompt and effective commercialization of its technologies, NEC has introduced a two-pronged management system centered on business readiness level (BRL), which indicates the maturity of a business, and technology readiness level (TRL), which indicates the maturity of a technology. Since the system was introduced, the time taken from research phase to practical application has been shortened by 15%, the number of technologies brought to practical application has increased by 20%, and the total number of commercialized technologies has increased approximately 1.5-fold. By closely tracking TRL and BRL and aligning research results with businesses, we have been able to shorten the time taken to commercialize technologies and improve the efficiency of research and development. We use ROIC as a KPI in process management for commercialization in existing business areas and are working to increase the speed of research and expand the scope of our businesses by increasing the number of technologies brought to practical application. In new business areas, we will introduce gate screening given the progress of commercialization, restrictions on the Generate and Ideate stages, and process management based on the degree of growth according to external evaluations to examine the viability of establishing a business.

### Process Management for Commercialization Based on TRL / BRL



Note: Comparison between TRL/BRL progress evaluation in FY2020 and FY2021

### Business Incubation Progress (BRL)

By monitoring the progress of business development and utilizing BRL, NEC divides the progress of business development through to commercialization into five stages: Generate, Ideate, Develop, Launch, and Operate. In the Generate stage, we carry out market research and lay out business ideas, visions, and strategies. In Ideate, we examine the viability of a business and formulate a business model along with an outline of a business plan. In Develop, we develop products and make preparations to launch a business, as well as formulating an ROI/financing plan. In the Launch stage, we bring the business to market and aim for expansion while accelerating monetization. Finally, the Operate stage is where we carry out the ongoing operation of the business. To enhance the effectiveness of the business development process, we make investment decisions by setting milestones for each stage, and third parties evaluate the maturity and business value of business plans that have undergone a certain level of market validation as leading indicators of a business. We are also working to improve effectiveness through various programs aimed at strengthening human resources for business development.

### Business Development Process

| Generate | Ideate | Develop | Launch | Operate |
|---|---|---|---|---|
| Market research<br>Business vision<br>Business strategy<br>Business idea | Business validation<br>Business model<br>Rough business plan | Product development<br>Business launch<br>Formulation of ROI / financing plan | Market introduction<br>Business expansion / Accelerate monetization | |

| | |
|---|---|
| Process | Adopt "lean start-up," define overall process from generating business idea to commercialization |
| Investment decision | Investment decision at each milestone of the stage gates, set focus areas, exit & pivot through portfolio management |
| Project evaluation | For business plan after certain market validation, as leading indicator, evaluate maturity and business value periodically by a third party |
| HR development | With cycle of training/execution/reflection, provide abundant menu to promote growth of business development personnel and operate a community of 1,600 members for mutual learning & information sharing |

Innovation: R&D and Business Development

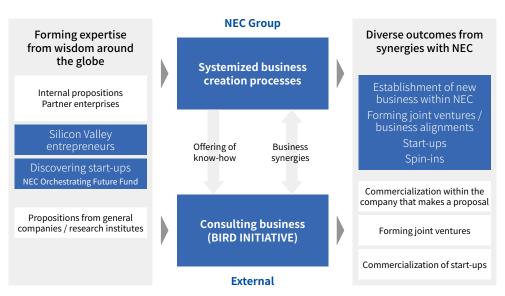## New Business Development

### Aiming to Create Business Value

Since its founding, NEC has developed new businesses in a variety of ways to spur innovation and provide value to society through the implementation of technology. The birth of new businesses stems from the resolution of social issues, to which end we are currently aiming to create value in new areas linked to the NEC 2030VISION, including healthcare, carbon neutrality, agriculture, and data-driven DX. We have set a target of ¥300 billion in value creation through new businesses in fiscal 2026 and are taking on the challenge of creating business value through a variety of co-creation methods.

### Management Policy for New Business Development

Development of new businesses begins not only in-house but also from gathering ideas from around the world via proposals that focus on both essential technologies and the market. We incorporate these ideas into a systemized process for creating new businesses to expand the entry and exit points for business 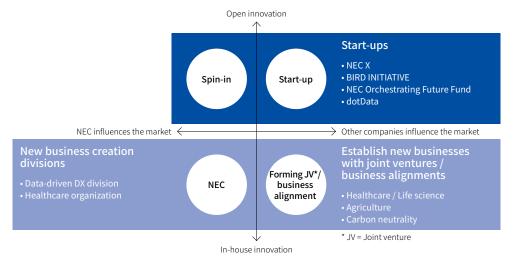creation through global collaboration and ecosystems, and consider a variety of outcomes, such as whether to commercialize the idea internally, establish a start-up company, or create a joint venture with an external partner. In addition, we are working to create further synergies by deploying the expertise we have gained through the creation of new businesses outside the Company in the form of consulting services.



### Outcomes

Outcomes are separated into two types: new domain-type businesses and start-up collaboration-type businesses. New domain-type businesses are developed in the form of a joint venture or business alliance in a market where other companies are developing their businesses, but where NEC also possesses the technological capabilities as well as the necessary knowledge and expertise of its customers' domain cultivated through its existing businesses. In the case of new domain-based businesses, we aim to contribute to earnings through business expansion. With start-up collaboration-type businesses, on the other hand, NEC aims to create new businesses by providing technology and establishing start-ups in areas where other companies have an advantage, but the market is highly promising. In the case of start-up partnerships, the know-how, capital gains, and other benefits gained from such partnerships will be returned to NEC.



### 1 New domain in-house innovation-type businesses

New domain-type businesses are focused on the healthcare/life science, agriculture, and carbon neutrality fields. The accumulation of ICT and domain-related technologies, which NEC possesses in these areas of focus, is essential to new domain-based businesses. We have been involved in the life sciences since 1998 and agriculture since 2013 and have exceptional technologies in these areas. Equally necessary is the domain knowledge and data possessed by our trusted partners. By combining these essential elements, we will construct a business model that will give us the edge over our competitors.

ℹ️ For more details on NEC's green, carbon-neutral, healthcare, and life science initiatives, please refer to "Future Growth Businesses" on pages 25 and 26.

Innovation: R&D and Business Development

## 2 ▶ Collaboration with start-up-type businesses

In start-up collaboration-type businesses, NEC and external partners co-create a start-up company to launch a business in a promising area with high future potential. Characteristics include open innovation involving external entities, external funding, and the use of external technologies, enabling rapid commercialization through collaboration not only within NEC but also externally. Major initiatives currently underway include the creation of the new businesses dotData, BIRD INITIATIVE, and NEC X. We are working to expand co-creation by providing the business development expertise gained from these initiatives to external entities as consulting services.

### 1. dotData, Inc.

#### Expansion of New Businesses through Collaboration between dotData and NEC's Data-driven DX Business

- dotData was founded and promoted by a leading NEC researcher.
- Using AI technology, the company 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. In total, dotData has provided products to approximately 100 companies.
- The company completed Series B financing in spring 2022 ($74.6 million in total).

### 2. BIRD INITIATIVE, Inc.

#### A First-of-Its-Kind R&D Business in Japan Centered on Co-Creation

- BIRD INITIATIVE was established by six operating companies including NEC, financial companies, and academia. The company accelerates new business creation through R&D co-creation.
- The company conducts R&D, contract research, consulting, and investment related to digital technology. To address social and organizational issues that are becoming increasingly complex due to the advancement of digitalization, the company works to resolve issues and create new businesses.

Established by six companies from different industries, incorporating business, finance, and academia, September 2020

BIRD INITIATIVE

Orchestrating a brighter world

NEC

大林組 OBAYASHI

JIP JAPAN INDUSTRIAL PARTNERS, INC.

JIA Japan Investment Adviser

CTC Challenging Tomorrow's Changes

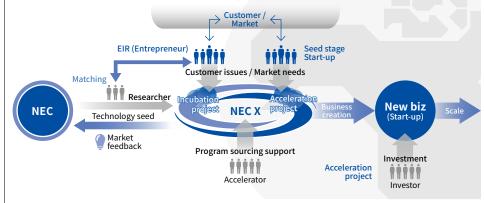東大IPC Innovation Platform for The University of Tokyo

### 3. NEC X

#### New Business Development with U.S. Investors and Entrepreneurs

- NEC X was established in California to accelerate new business development based on the strengths of its laboratory's technology, in collaboration with the Silicon Valley start-up ecosystem.
- To expedite commercialization, the company actively collaborates with external personnel and publicly discloses the technologies it possesses to solicit commercialization ideas from entrepreneurs.
- A total of 12 projects have been launched since 2021.

## NEC X
### Business creation leveraging Silicon Valley resources



| Metabob | Code review and debug support services for software developers |
|---|---|
| eCommerceInsights.ai | Product review comment analysis service for e-commerce sellers |
| NavigateIO | Infrastructure-free, real-time location-based solution for first responders |
| Real Quali | Platform matching service for real estate brokerage agents and buyers/sellers |
| Beagle technology | Automated pruning/bud picking solution for farmers |
| peace of mind | Platform and application offering mental health improvement and resilience programs for employees |
| Flyhound | Search and rescue support solution using drones to locate missing persons |

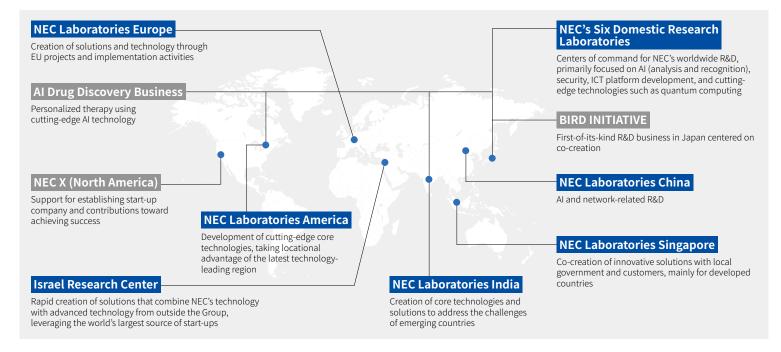## Developing People and Environments to Drive Innovation

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 R&D department belongs to research institutes abroad, where they are assigned purely on merit. We also focus on developing high-potential human resources who will be responsible for creating innovation, and we provide a high-return benefits system based on market value to highly skilled professionals with outstanding skills. Specifically, we aim to develop a group of professionals with a fresh set of skills and values by introducing the Selective Compensation Program for Professional Researchers to attract top young researchers.

In addition, NEC's laboratories are responsible for strengthening the core competencies of its technologies through R&D, as well as promoting innovation that co-creates new social value and opens up the future while collaborating with its bases and laboratories around the world.

Furthermore, by owning the largest supercomputer for AI research among Japanese companies, NEC is working to build environments to generate innovation.

### Human Resources—The Source of Innovation



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

**AI Drug Discovery Business**
Personalized therapy using cutting-edge AI technology

**NEC X (North America)**
Support for establishing start-up company and contributions toward achieving success

**NEC Laboratories America**
Development of cutting-edge core technologies, taking locational advantage of the latest technology-leading region

**Israel Research Center**
Rapid creation of solutions that combine NEC's technology with advanced technology from outside the Group, leveraging the world's largest source of start-ups

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

**NEC's Six Domestic Research Laboratories**
Centers of command for NEC's worldwide R&D, primarily focused on AI (analysis and recognition), security, ICT platform development, and cutting-edge technologies such as quantum computing

**BIRD INITIATIVE**
First-of-its-kind R&D business in Japan centered on co-creation

**NEC Laboratories China**
AI and network-related R&D

**NEC Laboratories Singapore**
Co-creation of innovative solutions with local government and customers, mainly for developed countries

### Human Resource Acquisition and Cultivation to Boost Innovation

| | | | |
|---|---|---|---|
| **Introduction of the Selective Compensation Program for Professional Researchers to attract top young researchers** | • Provides researchers with compensation according to their market value, with no upper limit<br>• Launched program in fiscal 2020 in Japan and extended it to applicable new graduates during recruitment activities in the U.S.<br>• Total number of researchers acquired: 22 | **Internal side business system (within Global Innovation Unit)** | • Implemented system to accelerate integration of R&D and Business Development divisions<br>• Aimed at developing human resources who are highly skilled in both technology and business |
| **Continued enhancement of our acquisition of excellent talent from India and other countries** | • Have engaged in recruitment activities at India's prestigious Indian Institutes of Technology (IIT) since 2012<br>• Part of our continued efforts to keep acquiring top talent from around the world | **System for highly skilled business development professionals** | • High-risk, high-return system providing highly skilled business development professionals with benefits based on their market value<br>• Established the new position of Executive Analytics Consultant Lead for data-driven DX-related business in fiscal 2022, in addition to AI drug professionals |