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Creating New Business through Open Innovation

Creating New Value through the New Businesses of Overseas SoftBank Corp. Group Companies

Leveraging its connections to leading companies around the world, SoftBank Corp. is determined to create innovative businesses and deploy new technologies and business models in Japan while building a highly professional workforce to support the expansion and spread of those new businesses.

To accelerate the transformation of lifestyles and industries, SoftBank Corp. will go beyond the bounds of a communications carrier to deliver a steady stream of innovative services in a wide range of domains, including fintech, mobility and healthcare, through the use of such cutting-edge technologies as AI, IoT and 5G as well as partnerships with outstanding companies in Japan and around the world.

SoftBank Corp. is committed to building frameworks for recruitment, training and business creation that will drive growth and to being an early mover in developing businesses to serve next-generation needs. For these purposes, SoftBank Corp. hires and trains personnel who have advanced professional skills and builds frameworks that become key drivers of new business creation. We regard these efforts as key initiatives to create businesses.

To further the "Beyond Carrier" strategy, we are advancing R&D using state-of-the-art technologies, working toward society-wide optimization in order to provide services that enable lifestyles of greater convenience and abundance while solving social issues.

We are approaching an era in which the Internet and digital technologies will facilitate connections between all industries and all spaces will be filled with telecommunications signals; communication will be possible anywhere, and software will be able to create anything.

In order to build such a future, since 2017, SoftBank Corp. has been actively working to uncover and develop new technologies—from next-generation networks to stratosphere-based high-altitude platform stations (HAPS) and autonomous vehicles—and develop them into businesses.

In addition to further accelerating these initiatives, on April 1, 2022, we established the Research Institute of Advanced Technology. Under the direct control of the President and CEO, the institute is aimed at fostering even freer thinking to take on new challenges and spur collaboration with leading-edge players around the world. This is the first time since SoftBank's founding that the company has created an organization with the title of "Research Institute."

Applying cutting edge technologies, from network technologies and engineering to digital art, data and trust, we will solve the issues facing society going forward to create the future.

Social Issues

Advance innovation using ICT platforms: Promoting the widespread adoption of cashless settlement, securing means of transportation amid the difficulties posed by an aging population and low birthrate, facilitating online healthcare, and enabling access to communications in developing countries

Value Creation

(1) Develop new business models with cutting-edge technologies
(2) Incubate and spiral-up cutting-edge businesses overseas
(3) Build systems to recruit and develop human resources to lead growth and create new businesses

KPIs

(1) Promote initiatives for HAPS commercialization
 • Development of foundational technologies for realization of HAPS
 • High-performance lightweight battery commercialization (FY2025)
 • Practical application of highly efficient lightweight motors for stratosphere (FY2027)
 • Development of stratosphere-ready radio equipment for telecommunication services (FY2027)
(2) Promote business start-up and development in new business areas
(3) Promote SoftBank InnoVenture commercialization

Risks and Opportunities

Risks
• Loss of business opportunities due to delay of business development resulting from shortages of required human resources and knowledge
• Inability to recoup invested funds or impairment losses due to failure to achieve expected results

Opportunities
• Quickly secure market share through the acquisition of human resources and knowledge and speedy business development through collaboration with partners
• Advancement and deepening of innovation through co-creation and expansion of the scale of businesses and markets in which the group participates

Main Businesses and Initiatives

• Develop new businesses to promote the social implementation of digital technologies (mobility × AI: MONET Technologies Inc.; stratosphere-based high-altitude platform station: HAPSMobile Inc.; autonomous mobility: BOLDLY Inc.)
• Promote next-generation infrastructure frameworks
• Roll out successful SoftBank Vision Fund projects in Japan and overseas through global partnerships (WeWork Japan, PayPay Corporation, DiDi Mobility Japan Corp., etc.)
• Job posting system to shift human resources to new and growing businesses
• Allocate personnel to new businesses through improvements in operational efficiency
• Human resource recruitment, development, systems* and compensation necessary to create and promote new businesses
• Cutting-edge R&D

* SoftBank Academia, SoftBank InnoVenture, SoftBank University

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Creating New Business through Open Innovation

Key Person Interview

Miki Fukazawa
Corporate Officer, Alliance Strategy Division Head

Expanding Businesses in New Sectors to Build a Sustainable Society

Under its corporate philosophy of "Information Revolution — Happiness for everyone," I believe that creating new systems and values to realize greater prosperity is part of SoftBank's social mission. While working to solve a variety of issues facing the planet and society, we will focus on such technologies as AI and cutting-edge business models to expand businesses in new sectors and contribute to the creation of a sustainable world.

SoftBank's Investment Strategy and Strengths in Business Development

Our "Beyond Carrier" growth strategy is aimed at going beyond the framework of communications carrier to proactively expand group businesses in a wide range of fields within the information and technology sector and thereby maximize corporate value. Aiming to create new businesses and further expand corporate value, we will formulate and execute investment strategies in accordance with SoftBank Corp.'s medium- to long-term strategic themes.

One of SoftBank Corp.'s strengths in creating new businesses lies in our collaborations with global AI companies and unicorns that are portfolio companies of SoftBank Group Corp. as well as other partners in and outside Japan. SoftBank Corp. has a wealth of sales and technological capabilities, as well as a store network and communications infrastructure developed mainly through its communications and Internet businesses. On top of these, we also have one of the largest bases of customers touchpoints in Japan through Yahoo! JAPAN, LINE, PayPay and other businesses. I think that the ability to rapidly launch new businesses by making maximum use of these assets is a unique strength of the SoftBank Group.

Solving Social Problems and Transforming Lifestyles

SoftBank Corp. aims to not only create and expand new businesses, but to use cutting-edge technologies to solve all kinds of social issues and transform people's very lifestyles. For example, through its HELLO CYCLING share cycle service, OpenStreet is deepening cooperation with numerous municipalities, improving mobility within communities, and helping solve community issues, such as that of abandoned bicycles. OpenStreet now has more than 6,300 stations across Japan and has surpassed 2 million members. Furthermore, the number of municipalities that have formed agreements related to share cycle services and the use of public land now exceeds 100. Through these efforts, we are helping realize short-distance transportation infrastructure services rooted in communities and thus contributing to the solution of local social issues.

PayPay, meanwhile, has significantly transformed lifestyles by spreading the use of cashless payments. The numbers of PayPay users and member stores have continued to grow since the service's launch in 2018. Today, PayPay boasts the top share of the domestic code payment market, with 58 million registered users, 2.35 million payment locations, and more than 5.1 billion transactions in FY2022. In addition, more than 10 million customers have used a new service developed in collaboration with PayPay Securities to lower the threshold for investment by enabling investment using points. Through such efforts, we are working to further transform lifestyles through PayPay. Going forward, we will continue to solve social issues and drive lifestyle change through innovation powered by new business creation.

In Closing

By finding cutting-edge technologies and business models and promoting their growth through investment, we will solve social issues and work toward the future growth of SoftBank Corp. while contributing to the realization of a sustainable world.

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Creating New Business through Open Innovation

Value Creation 1

Develop New Business Models with Cutting-edge Technologies

Advantages in New Businesses and Business Promotion

The SoftBank Corp. group is proactively promoting the expansion of new businesses utilizing cutting-edge technologies and business models in AI, IoT, fintech, security, mobility and other domains. In terms of the creation of new business, by leveraging the strengths built up through our communications business in collaboration with leading-edge AI corporate groups worldwide in which our parent company, SoftBank Group Corp., has invested, we are able to launch businesses efficiently with minimal initial investment compared to doing so independently.

SoftBank **+** SoftBank Group portfolio companies

Full utilization of the SoftBank Corp. group's platforms and assets

Principal subscribers **Approx. 40 million**[1]	Transactions with about **93%**[2] **of major corporations**	Consolidated employees **Approx. 55,000**	Stores **Approx. 6,500**[3]	Business platforms (networks, IT, billing, etc.)

1. Cumulative main mobile subscribers (as of June 30, 2023)
2. Approximate share of Japan-listed companies with annual sales of ¥100 billion or more that do business with SoftBank Corp. (as of March 2023)
3. Total SoftBank and Y!mobile directly managed retail outlets, agency stores, big box electronics retailers and shops offering multiple carriers (as of March 2023)

Three Competitive Advantages

1. Unrivaled Customer Contact Points
The SoftBank Corp. group possesses one of the largest user bases in Japan across a wide range of fields, including telecommunications, online shopping, payments and social media. Moreover, the group has mobile phone shops across the country serving as touchpoints with consumers and does business with nearly all of the large enterprises in Japan. Through customer contact points across multiple fronts, with both individuals and enterprises, in-person and online, our new businesses are able to reach an extensive range of consumers and companies from the early phases of launch.

2. Collaboration with SoftBank Group Investees
Our parent company, SoftBank Group Corp., invests in unicorn companies worldwide through funds and other means. As a member of the SoftBank Group, we are able to collaborate with these companies and develop their cutting-edge technologies and business models into new businesses.

3. Powerful Sales and Technological Capabilities
Our highly capable sales force is known for having explosively popularized ADSL in Japan through an innovative sales approach in the early 2000s. At the same time, we put considerable effort into securing technological personnel and have a total of more than 10,000 engineers group-wide.* Leveraging these powerful sales and technological capabilities enables us to rapidly establish new businesses.

* Total engineers of SoftBank Corp., Yahoo Japan Corporation, LINE Corporation, etc. (as of March 2023)

Main New Business Domains

- Communications
- Mobility
- Big Data and AI
- Location and Real Estate
- Healthcare
- Fintech
- Security
- Energy

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Creating New Business through Open Innovation

Value Creation 1 ## Develop New Business Models with Cutting-edge Technologies

Communications

Stratosphere-based High-altitude Platform Station (HAPS)

Established as a subsidiary of SoftBank Corp. in 2017, HAPSMobile Inc. aims to develop business globally by building a high-altitude platform station (HAPS) system that provides network connectivity from the sky.
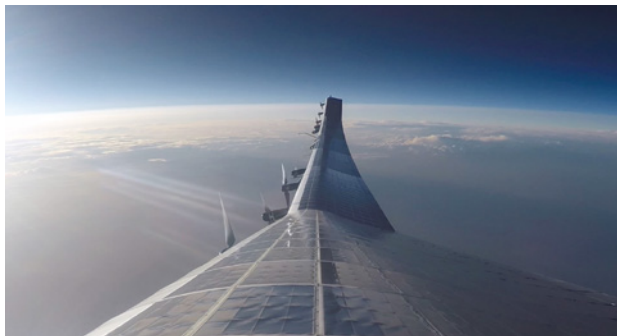
HAPSMobile has developed the Sunglider unmanned aircraft with its aircraft development partner, U.S.-based AeroVironment, Inc. On September 21, 2020, Sunglider undertook its fifth test flight out of Spaceport America in New Mexico. The test achieved successful stratospheric flight just three years after the start of fuselage development. It also marked the world's first successful LTE transmission from the stratosphere using a HAPS autonomous flight system.

HAPS uses unmanned aircraft flying in the stratosphere that operate like telecommunications base stations, enabling the creation of a stable Internet connection environment in regions where telecommunication networks have not been established, such as mountainous regions, remote islands and developing countries. HAPS can provide network coverage over a wide area from the stratosphere down to the ground, contributing to the uptake and effective use of drones, as well as the spread of IoT and 5G. Because these systems can provide stable communications networks regardless of conditions on the ground, they are expected to contribute greatly to rescue and recovery efforts after major natural disasters.

In February 2020, the HAPS Alliance was established under the leadership of HAPSMobile as an industry organization bringing together the world's leading companies in the telecommunications, technology and aviation industries, as well as governments, universities and research organizations, to advance the provision of Internet communications utilizing high-altitude aircraft. The alliance seeks to coordinate advocacy to relevant authorities in various countries, develop common HAPS product specifications, promote interoperability through the standardization of HAPS technology and set up aviation-related operational systems. Through these activities, the alliance aims to resolve various social issues and create value by building an Internet connectivity environment covering the entire planet utilizing high-altitude communication networks and aircraft. Through the HAPS Alliance, we aim to realize a world where anyone can access information, and we will continue activities to expand global-scale Internet communications.

We are working to set up the systems and develop the elemental technologies needed to commercialize HAPS. On the systems side, in terms of international radio frequency systems, we are advocating for an expansion of the HAPS spectrum bands at the International Telecommunication Union's World Radiocommunication Conference 2023 (WRC-23; amendments to the Radio Regulations are expected to enter effect in January 2025). We have achieved the international standardization of a radiowave propagation prediction method for accurately estimating radiowave interference at high altitudes, which will be necessary for consideration at WRC-23. The prediction method will also be useful for the design of HAPS network coverage areas. We will continue to advance international standardization efforts to improve the prediction method. In terms of aviation systems, we are advocating with regulatory and standardization authorities to clarify the position of HAPS under the Convention on International Civil Aviation and its annexes while advancing initiatives to make necessary changes to national aviation systems.

In elemental technologies, we are advancing R&D in such areas as batteries, motors and radio equipment. In batteries, to extend flight times, we aim to develop and commercialize more efficient, lightweight batteries by FY2025. In motors, we are working to develop highly reliable, high-efficiency, lightweight motors that can help realize longer stratosphere flight times by FY2027. We are also developing radio equipment, with the aim of enabling stable, high-speed communications from the stratosphere by FY2027, along with a variety of other elemental technologies.

We will continue to work to address the remaining hurdles to HAPS commercialization. By steadily resolving each of these issues in turn, we aim to provide network service over wide areas, including sparsely populated regions. In addition, because the Sunglider unmanned aircraft developed by HAPSMobile operates on solar power, it will contribute to the achievement of Sustainable Development Goal 7, "Ensure access to affordable, reliable, sustainable and modern energy for all."

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Creating New Business through Open Innovation

Value Creation 1 — **Develop New Business Models with Cutting-edge Technologies**

Mobility

MONET: Pursuing the Potential of Mobility Services

MONET Technologies Inc. is a joint venture between SoftBank Corp. and Toyota Motor Corporation, with capital participation from other companies, that commenced operations on February 1, 2019. MONET's objective is to create new value and solve social issues related to transportation in collaboration with local governments and other companies.

In Japan, mobility as a service (MaaS) has drawn attention as a potential solution for a variety of social issues, such as traffic jams in urban areas, traffic accidents caused by older drivers, an increase in elderly people who have turned in their drivers' licenses and now have difficulty getting around, areas without public transportation due to depopulation, and driver shortages. MONET is working toward the realization and spread of new mobility services that bring people, goods and services together. These include streamlined mobility services using on-demand vehicle-dispatch platforms, as well as mobile convenience stores, clinics and offices.

Launch of Service for Enterprises Enabling On-demand Bus Reservations through LINE

In July 2023, MONET launched a service for reserving on-demand buses through the official LINE accounts of municipalities and businesses. This service is provided as an option for enterprises to allow them to provide on-demand buses and other MaaS in a single package through LINE. It features a simple user interface (UI) that allows users to make reservations using intuitive controls within the LINE app. The UI has been distilled to the minimum necessary functions for ease of use by seniors and other users who may feel uneasy about operating complex, multifunctional smartphone apps.

On-demand bus reservation home screen

Desired pick-up time selection

BOLDLY: Sustainable Public Transport Using Autonomous Vehicles

Against the backdrop of bus route closures and driver shortages, BOLDLY Inc. is providing support for the implementation of self-driving buses across Japan and provides the Dispatcher platform for self-driving fleet management. Through these and other initiatives, BOLDLY is working to realize convenient and sustainable mobility services using autonomous vehicles.

Start of Regular Operation of Self-driving Bus Launched in Kamishihoro, Hokkaido

On December 1, 2022, MONET began regular services of a NAVYA ARMA self-driving bus in the town of Kamishihoro, Hokkaido. Phase 1 of the project has utilized Level 2 driving automation since initiating regular bus service in December. Marking a major transition, Phase 2 is scheduled to commence during FY2023, with the aim of realizing the practical implementation of Level 4 automated driving service in an urban area.* Population decline and other factors are increasing the difficulty of maintaining existing public transportation in this area. In response, by operating self-driving buses on regular schedules and routes around town, this initiative aims to help create opportunities for residents to get out, invigorating the community and promoting greater health while realizing sustainable public transportation.

* For some time after the transition, the bus will operate at Level 2 in some situations, such as at intersections with traffic signals.

Bus route

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Creating New Business through Open Innovation

Value Creation 1   ## Develop New Business Models with Cutting-edge Technologies

Big Data, AI and Location

ichimill High-precision Positioning Service

ichimill is a service that enables positioning with a margin of error of only a few centimeters via RTK positioning[1] using signals from a GNSS,[2] such as the Michibiki quasi-zenith satellite system.

SoftBank Corp. has installed over 3,300 unique electronic reference points (fixed stations), which are necessary for RTK positioning, at its base stations across Japan, so users do not have to set up reference points of their own.

Correction data is generated by a "Positioning Core System" based on signals received by the unique reference points and sent to GNSS receivers (mobile stations) mounted on agricultural machinery, construction equipment, automated vehicles, drones and other equipment using SoftBank Corp.'s mobile communications network.

RTK positioning uses this correction data and signals received by GNSS receivers for highly accurate centimeter-level positioning in real time.

1. RTK positioning: Real time kinematic position, a method of high-precision positioning by sending signals between a fixed station and a mobile station in real time
2. GNSS: Global navigation satellite system, a general term that includes quasi-zenith satellite systems (QZSS), GPS, GLONASS and Galileo

RTK Positioning
GNSS
GNSS signal
GNSS signal
Correction data generation
GNSS signal
Correction data
Margin of centimeters
SoftBank unique control points
Positioning Core System
SoftBank mobile network
GNSS receivers (mobile station)
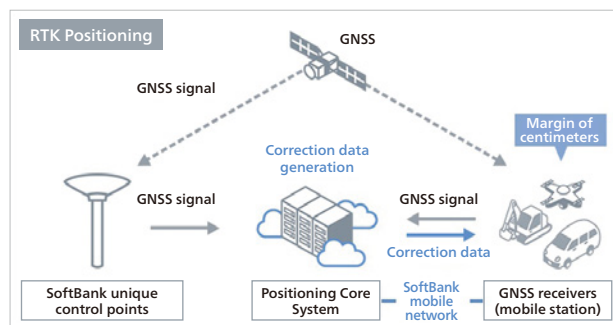
Generating and Transmitting Position Correction Data: The ALES Transmission System

ALES provides the ALES Transmission System, which generates correction data based on signals received by more than 3,300 unique reference points across Japan and transmits this data to GNSS receivers.

The ALES Transmission System is used by ichimill,* a high-precision positioning service provided by SoftBank Corp. to corporate clients. ALES also uses this system in the Centimeter-level Positioning Service for consumers, launched in August 2020.

This service, which enables high-precision positioning, is put to use in a wide array of industries, from agriculture to construction and automotive.

In agriculture, it is applied in the automated and assisted driving of tractors and other agricultural machinery, as well as the automatic navigation of drones used in crop dusting. The construction industry applies the service in surveying and the management of positioning and work histories of construction equipment. In the automotive industry, the service is expected to be used in highly precise self-locating of autonomous vehicles, as well as in MaaS, where it is anticipated to enhance vehicle position management, route management and navigation.

Through the provision of the ALES Transmission System, ALES works with a wide range of partner companies to develop and implement innovative GNSS solutions to make people's lives richer and more convenient than ever.

* Within SoftBank Corp.'s ichimill, the ALES Transmission System is referred to as the "Positioning Core System."

Agoop Brings New Perspectives to Business with Big Data Using Positioning Information

Agoop Corp. is engaged in big data operations using positioning information. Based on positioning data acquired from apps on the smartphones of consenting users, Agoop generates and analyzes data on floating populations, which is a valuable tool for tasks such as trading-area analysis, marketing, tourism analysis, disaster preparedness and urban planning. The data provided by Agoop is used by organizations ranging from companies to academic institutions and local governments. Floating population data can unlock possibilities for a more affluent society, as it can reveal demand in a wide range of businesses, including health products and services, healthcare, medicine, social services, disaster preparedness, crime prevention, transportation, tourism, education and finance.

On March 31, 2023, Agoop formed an agreement to cooperate on disaster-resilient community building with the Disaster Management Research Institute of the Japanese Red Cross College of Nursing, aiming to promote disaster countermeasures and support community recovery and development. The two organizations have previously conducted joint pilot tests aimed at using floating population data and AI to understand the status of tsunami evacuation in real time. Going forward, they will further strengthen their collaboration, working together to advance disaster countermeasures alongside community recovery and development.

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Creating New Business through Open Innovation

Value Creation 1 · Develop New Business Models with Cutting-edge Technologies

Big Data, AI and Location

Japan Computer Vision Offers AI-driven Image Recognition Solutions

SoftBank Corp. subsidiary Japan Computer Vision Corp. provides cutting-edge AI-driven solutions for smart buildings and the smart retail sector. By enhancing and raising the efficiency of office environments, optimizing the layout of stores and commercial facilities, helping improve hospitality and streamlining payment, Japan Computer Vision is creating workstyles and lifestyles for a new era.

Japan Computer Vision's SenseThunder AI temperature detection combines AI-based facial-recognition technology with an infrared camera to take temperature readings from a distance and conduct high-speed, high-precision measurements even of subjects wearing a surgical mask and glasses, enabling people to enter premises without removing their masks. The system does not take much space to install and does not require an operator, so there is no human resource burden, such as the need to assign staff to temperature measurement at reception. Thanks to these merits, it is widely used at national and local government offices, companies and medical facilities to prevent the spread of COVID-19. SenseThunder is also contributing to the improvement of corporate operational efficiency and DX in such applications as attendance management, access control and reception management.

Incudata Uses Data to Support Corporate Clients in Advancing DX

Incudata Corp. is a joint venture between SoftBank Corp., Hakuhodo Inc. and Treasure Data, Inc.

By combining SoftBank Corp.'s data and technology with the Hakuhodo Group's marketing and consulting capabilities, Incudata provides one-stop support for customers, from formulating data strategies to building and operating analytical platforms utilizing Treasure Data CDP and implementing related measures, with ongoing support until customers see results from data utilization.
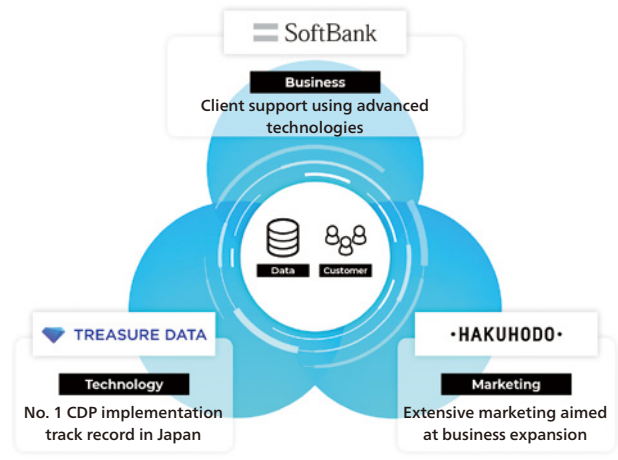
In recent years, more and more companies have been focusing on DX to improve customer experience value and streamline internal operations. Business transformation centered on the use of digital technology and data is becoming increasingly necessary for companies to secure ongoing growth and competitive advantage. However, in many cases, DX ends up taking up enormous amounts of time, as the man-hours and tasks to be tackled are wide ranging. These can span building data analysis platforms to introducing appropriate IT tools, setting up and strengthening DX promotion organizations and systems, as well as training human resources. Incudata has helped many companies implement DX projects in the marketing sector by consulting on data utilization strategy planning, data analysis platform building and operation, and data privacy protection, as well as associated security system building and operation. Incudata will leverage the insights obtained through these services going forward to rapidly and powerfully advance corporate DX and thereby help solve issues that businesses face.

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Value Creation 1 **Develop New Business Models with Cutting-edge Technologies**

Big Data, AI and Location

Helping Solve Internet Use Issues through IX: BBIX, Inc.

SoftBank Corp. subsidiary BBIX, Inc. conducts Internet exchange (IX) operations with a mission of spreading and developing the Internet, to create a world in which everyone can use the Internet with ease and convenience. The company has operations in Asia, including Japan, as well as Europe and North America.

BBIX allows customers to connect to its many IX connection points in convenient locations in Japan and overseas to enable major Internet service providers (ISPs), content providers and CATV businesses around the world to directly connect to one another, helping realize a low-latency, high-quality communications environment.

Furthermore, since May 2022, BBIX has been providing Open Connectivity eXchange (OCX), a cloud-based network service, mainly for enterprises. OCX provides on-demand connectivity to a variety of cloud services and data centers used by customers via a dedicated customer portal. This eliminates the need for customers to purchase and maintain network equipment, reducing costs.

Leveraging its IX platform, BBIX will contribute to enhancing Internet connection quality and reducing costs for customers.

Healthcare

Solving Social Issues in the Healthcare Field: Healthcare Technologies Corp.

Healthcare Technologies Corp. is a SoftBank Corp. subsidiary established in the DX domain to promote solutions to a wide range of social issues in the healthcare field. Healthcare Technologies provides a healthcare platform to help improve people's health, optimize healthcare resources, and maintain universal healthcare coverage. Healthcare Technologies provides HELPO, a one-stop healthcare app that provides useful functions for disease prevention, improvement of presymptomatic disease and health promotion. HELPO added a telemedicine service in June 2021, as well as the HELPO Remote Specific Health Guidance function, developed based on the University of Tokyo Center of Innovation Self-Managing Healthy Society program's MIRAMED, in November 2021. Service for individual users was launched in December 2022.

▼ **Functions of HELPO**

Health/Medical Consultation	Expert medical team answers in chat
Telemedicine	In addition to normal telemedicine, after using the Health & Medical Consultation Chat, users can select the appropriate medical department for their needs
HELPO Mall	A Healthcare Technologies online store quickly delivers sundries and over-the-counter medicines
Clinic search	Search for clinics based on user-specific conditions
Step counting	A simple pedometer function that displays progress toward user-set targets
Remote specific health guidance (for companies and municipalities only)	Support for specific health guidance provided by companies and municipalities
Point program (for individual users only)	An original point program that offers special perks for daily walking

➜ HELPO—Promoting Healthcare DX P. 39

➜ HELPO Healthcare App P. 73

Fintech

From OMO to AI-powered Fraud Countermeasures: SB Payment Service Corp.

SB Payment Service Corp. provides a wide array of payment methods and systems tailored to customer needs in e-commerce, online shopping and in-person transactions at stores or elsewhere. Today, with the rapid uptake of AI, a wave of major change is sweeping through payments. To protect businesses from increasingly common fraudulent e-commerce transactions, SB Payment Service provides an AI fraud detection service via the same platform as its payment systems to realize a one-stop, comprehensive payment service.

In addition, as the company responsible for the SoftBank Group's fintech business, SB Payment Service is working with leading companies to proactively meet online-merge-offline (OMO) needs.

Drawing on an extensive track record, SB Payment Service caters to merchant settlement needs with a seamless, high-quality payment experience, offering a wide selection of methods to suit each operator's needs and line of business.

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Creating New Business through Open Innovation

Value Creation 2 — # Incubate and Spiral-up with Cutting-edge Businesses Overseas

SoftBank Corp. contributes to the maximization of economic opportunities through the creation of sustainable and groundbreaking business models that constantly advance and grow by strategically generating synergies through joint ventures and business tie-ups with leading-edge companies around the world.

Incubating and Spiraling-up Overseas Businesses through Group Synergy

Utilizing the success models and cutting-edge technologies of the global leading companies in which SoftBank Group Corp. has invested, SoftBank Corp. can roll out businesses in Japan quickly, with lower investment cost and risk than launching a business from scratch. Moreover, SoftBank Corp. extends the lessons from success stories in Japan to its overseas operations, generating a spiraling-up effect.
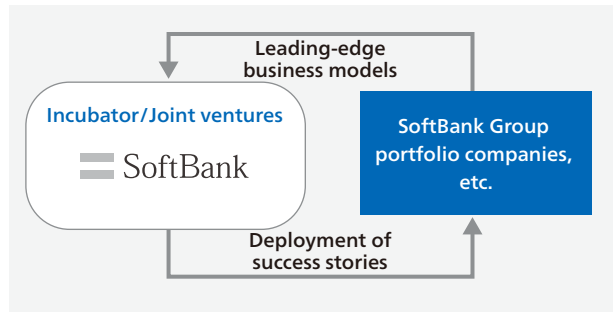
Fintech

PayPay Cashless Payment Service

Since launching services, SoftBank Corp. subsidiary PayPay Corporation has continued to increase its numbers of users and member stores, reaching 58 million registered users (as of June 2023) and more than 4.10 million registered locations (as of March 2023). The total number of payments in FY2022 (April 2022 to March 2023) exceeded 5.1 billion, about 1.4 times the volume in the previous fiscal year.

Over the years, PayPay has expanded the range of financial services that can be used smoothly and easily from within the PayPay app, including the PayPay Invest and the PayPay Hoken (insurance) mini-app.* As a new initiative, on April 1, 202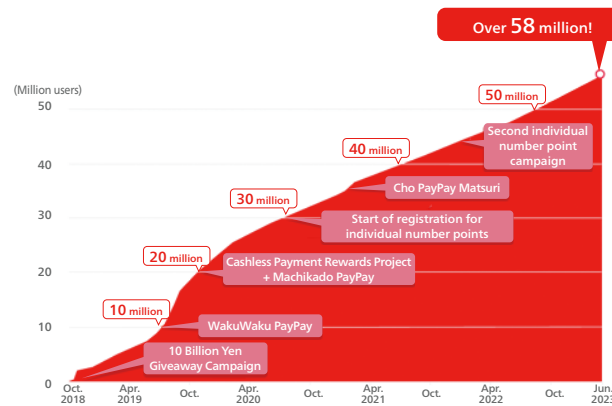3, PayPay filed an application with the Minister of Health, Labour and Welfare for specification as a funds transfer service provider in preparation to enable the digital payment of wages into PayPay accounts.

The payment of wages into digital wallets will not only provide greater freedom of choice with regard to methods for receiving wages for users (workers), but also improve convenience, as users will no longer need to bother with topping up their PayPay balances as they make payments. In addition, for enterprises (employers), such systems are expected to facilitate even more diverse workstyles, such as enabling side jobs, thereby offering benefits in terms of hiring, personnel and labor management.

By continuing to promote cashless payments while adding and expanding new services, PayPay will work to enhance customer convenience and societal productivity while contributing to sustainable business operations.

* PayPay Hoken mini-app: A feature that allows users to smoothly and easily reserve services or order products offered by partner companies of PayPay Corporation and make related payments through the PayPay app.

➜ For more on financial services initiatives centered around PayPay, please see page 68.

▼ **Cumulative Registered Users**

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Creating New Business through Open Innovation

Value Creation 2 **Incubate and Spiral-up with Cutting-edge Businesses Overseas**

Location and Real Estate

WeWork: Flexible Offices

WeWork Japan offers flexible offices that provide a lively work environment and efficient office operations for all employees, currently operating approximately 40 locations in seven cities in Japan.

WeWork offers a variety of office environments to meet the diversifying needs of customers, from satellite offices to headquarters. We also promote open innovation and community participation to create an environment where members can easily share new ideas and promote collaboration.

WeWork received the rank of "Best Workplace" (the highest of four ranks) and a diversity score of 87 points in D&I AWARD 2022. Run by JobRainbow Co., Ltd., this awards program recognizes companies leading the way in diversity and inclusion (D&I) in Japan. As a D&I leader, WeWork promotes D&I at a high level, not only for Japan but by global standards, and was highly evaluated for fostering a corporate culture of D&I and advancing initiatives to actively involve all employees in D&I promotion.


DiDi Taxi Dispatch Platform Service

Established in June 2018 as a joint venture between SoftBank Corp. and China-based Didi Chuxing Technology Co., Ltd., DiDi Mobility Japan Corp. provides an AI-enabled taxi dispatch platform.

DiDi Mobility Japan integrates Didi Chuxing Technology's taxi-dispatch platform, an advanced analytical and predictive technology using world-leading AI, with SoftBank Corp.'s marketing capabilities and operating platform as a communications carrier.

Using the DiDi taxi dispatch app, after users input their departure location and destination, a taxi arrives to pick them up in an average of five minutes.* The taxi dispatch platform matches available taxis with passengers via the app to optimize taxi dispatch. DiDi enables users to hail a taxi in three simple steps, and because the app automatically finds the route using the input destination, users do not have to give drivers directions. The app also enables cashless payment, eliminating the need to handle cash and make change, which can be cumbersome within a vehicle. By eliminating a variety of complaints and anxieties that users have about using taxis, the service allows passengers to travel by taxi with greater peace of mind.

* The arrival time of the affiliate vehicle to the specified location after the vehicle to be dispatched is determined (January–December 2022 national average). In some cases, dispatch may take more than five minutes, or there may be no vehicle available for dispatch.
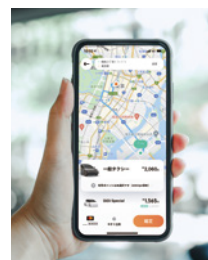
Tabist Offering New Travel Experiences Highlighting the Appeal of Accommodations Across Japan through DX in the Tourism and Lodging Industry

Tabist Co., Ltd. supports the DX of lodging facilities. To better highlight the appeal of lodging facilities in Japan, Tabist provides a stay management system suited to facilities in Japan and a dynamic pricing framework, thereby promoting the DX of the tourism and lodging industry.

In addition, the company aims to stimulate travel demand by bringing millennials into its customer base through the Tabist brand. Going forward, Tabist will focus on localization within Japan to build a brand tailored to needs in Japan while advancing the creation of new travel experiences that bring together the community of its partner lodging facilities, guests and other nearby facilities.

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Creating New Business through Open Innovation

Value Creation 2   ## Incubate and Spiral-up with Cutting-edge Businesses Overseas

Location and Real Estate

Mapbox Map Development Platform

Mapbox Japan ("Mapbox") is a joint venture established by SoftBank Corp. and U.S.-based Mapbox, Inc. As a leader in cartography, the joint venture provides Mapbox, a development platform for map data services. The platform promotes the effective use of a company's own location data. Corporate users can build maps, optimized to specific uses, by freely combining a variety of in-house and external data.

In April 2023, Mapbox commenced support for the development of digital map educational materials by Atsugi Senior High School and Atsugi-Seinan Senior High School in Kanagawa. As with the programming education that has become a mandatory part of study over the past two to three years, many teachers in Japan are still figuring out how to teach new integrated geography curriculum. The Mapbox map development platform makes it easy for anyone to create digital maps and has features that enable data integrated into maps to be displayed in a variety of easy to understand formats, such as heatmaps and graphs. As a result, many users have already developed and shared digital maps that are easy for teachers and students to use for classes on topics like natural disasters and preparedness using Mapbox. Noticing these features, teachers at the two high schools reached out to Mapbox, leading to the start of this initiative.

The developed materials and lesson plans will be further brushed up through use over the school year, with the aim of sharing them nationwide.
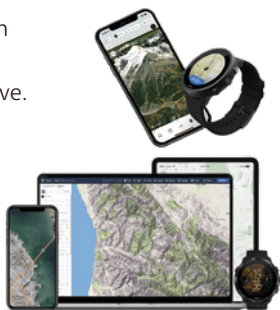
Security

Cybereason: A Service that Detects and Counters Cyberattacks in Real Time

Cybereason G.K. is the provider in the Japanese market of the AI-driven Cybereason cyberattack protection platform.

Since March 2022, Cybereason has implemented Cybereason XDR for a select group of users prior to the full roll out. This service correlates and analyzes log data across an organization's entire IT environment (including endpoints, networks, identity management and unified authentication, cloud and workspaces) to detect, understand and counter cyberattacks faster than ever before. In this way, the service is aimed at significantly reducing incident investigation and response times and solving issues posed by shortages of security professionals.

Having built a track record of multiple implementations in Japan and reflected feedback from the initial users, the company launched Cybereason XDR for all companies and organizations in Japan on April 3, 2023.

Based on the detection capabilities of Cybereason EDR, the highest rated product in the MITRE ATT&CK* Evaluations, Cybereason XDR automates the investigation of a wide range of sophisticated attacks and provides a complete picture of attacks, significantly reducing the time

Cybereason's goal:
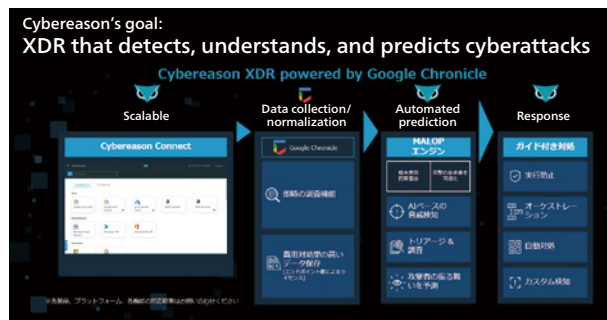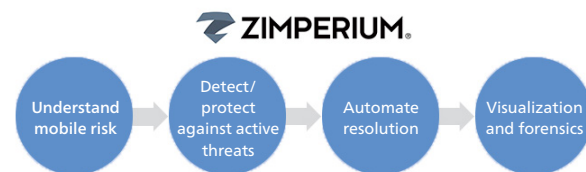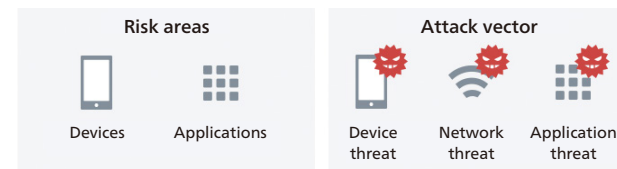**XDR that detects, understands, and predicts cyberattacks**

required to investigate and respond to customer incidents. Furthermore, when combined with managed detection and response (MDR) service, in which expert analysts monitor customers' environments 24 hours a day, 365 days a year, Cybereason XDR provides powerful support to customer security teams, solving the issues caused by professional shortages.

* A framework for understanding attacker tactics and techniques

zIPS Security Solutions for Mobile Devices

SoftBank Corp. offers zIPS, a mobile-security solution service for enterprises that defends against even unknown threats using the unique AI-equipped threat-detection engine of U.S.-based Zimperium, Inc.

At a time when attacks on mobile devices are constantly growing more serious, clearly understanding the risks these attacks present and taking effective action against them is a responsibility of every company and a necessary condition for business growth.

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Creating New Business through Open Innovation

Value Creation 2 Incubate and Spiral-up with Cutting-edge Businesses Overseas

Security

Unlike conventional signature-based security, zIPS detects unusual behavior generated by devices and attacks from operating system processes. This allows zIPS to respond to attacks against mobile devices regardless of the infiltration route, enabling companies to respond promptly and effectively.

Moreover, zIPS can be combined with enterprise mobility management (EMM), mobile device management (MDM) and other device management services. This enables a company's mobile device administrator to respond rapidly when a threat is detected to prevent it from propagating, for example by shutting down Wi-Fi service or locking devices remotely, keeping devices in use safe.
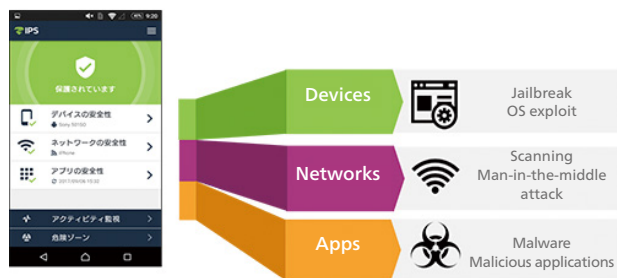
Energy

Encored Japan Provides Energy Data Analysis Platform to Enrich Lifestyles

Encored Japan Inc. aims to create new value and new services from energy data through innovative AI technologies and IoT products, and to contribute to the realization of a prosperous future that connects people to people and people to society.

Encored Japan provides products and technologies that gather energy and environmental data from the real world into the CONNECT Cloud, including data collected through CONNECT Hub and CONNECT Sensor IoT devices and data on electricity use in 30-minute increments from smart meters installed in homes. The CONNECT Cloud analyzes that input to draw out the most valuable data and provides a variety of services that can be accessed at any time through Connect Enterprise and Connect Apps.

Results

■ **24 corporate customers**
Encored Japan products and services based on the latest technologies are used by 24 corporate customers.

■ **2,322,540 households**
The CONNECT Cloud collects and analyzes approximately 100 million records of electronic and environmental data each day and through CONNECT Apps; Encored Japan products and services are provided to 2,322,540 households.

■ **Number of shipped products**
We have provided 136,644 CONNECT Hubs and CONNECT Sensors to households all over Japan through various services and industries, including real estate agents and city gas companies.

■ **Technology Patents**
As an energy tech company, Encored Japan has registered a total of 24 patents for technologies and systems, trademarks for products and services, and design rights.

As of July 2023

Note: Includes pending items filed and items filed by ENCORED and Encored Technologies

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Value Creation 3 | **Build Systems to Recruit and Develop Human Resources to Lead Growth and Create New Businesses**

In order to rapidly develop businesses that meet next-generation needs, SoftBank Corp. hires and trains personnel who have advanced professional skills and builds frameworks that become key drivers of new business creation. We regard these efforts as key initiatives to create businesses.

Human Resource Recruitment, Training and Business Creation for Next-generation Business Development

In order to train personnel who will create and advance new businesses, SoftBank Corp. operates unique training programs, including SoftBank InnoVenture and SoftBank Academia.

In addition, we are proactively advancing development focused on the next generation of cutting-edge technologies, such as AI, IoT, robotics, digital twin, and even 6G and HAPS. Through group synergy and collaboration with external companies and universities, we strive to create new value and new businesses by integrating diverse personnel and our accumulated technologies.

Through a variety of internal and external approaches, we will continue to advance recruitment and training while working to establish production bases and business operations for sustainable technologies, aiming to be a global leader across a wide range of fields.

➔ Human Resource Development P. 175–176

Providing Opportunities for Growth Aligned with Business Strategy

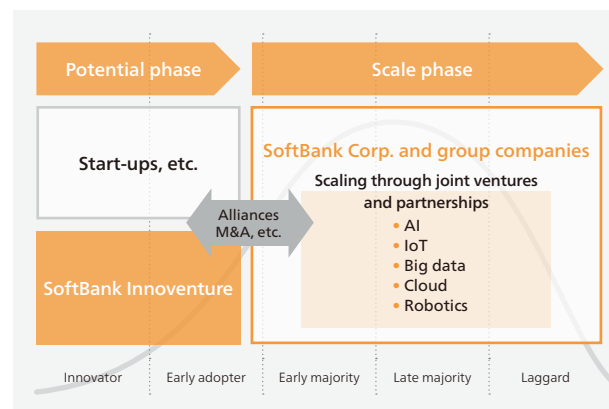**SoftBank InnoVenture
(InnoVenture = Innovation + Venture)**

SoftBank InnoVenture is an in-house entrepreneurship system launched as a part of the goal to become a strategic synergy group of 5,000 companies in line with SoftBank's Next 30-Year Vision, which was unveiled in 2010. The system solicits unique, innovative and creative ideas for new businesses from within and outside the company, and provides wide-ranging support from the pre-idea creation stage to scaling up after commercialization.

SoftBank InnoVenture will continue to help foster a corporate culture that accepts new challenges by strongly encouraging employees to come up with new business ideas.

▼ "Zero-to-One" Business Creation
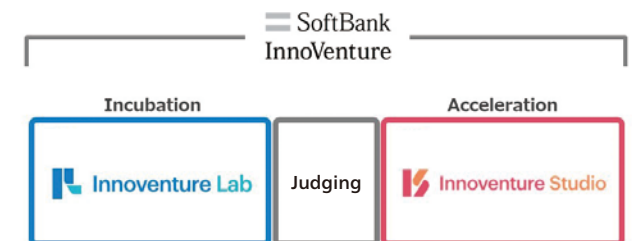

■ Strengths

1. Any employee of the SoftBank Group can make any number of proposals.
Proposals with outside partners are also accepted.

2. We provide attentive support at each business stage, from pre-proposal preparation to commercialization, and even exiting.

3. We operate SB Innoventure Corp. as a stand-alone company to provide an environment conducive to business study toward commercialization.

Overview of SoftBank InnoVenture

SoftBank InnoVenture provides wide-ranging support from the pre-idea creation stage to scaling up after commercialization.

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Creating New Business through Open Innovation

Value Creation 3   Build Systems to Recruit and Develop Human Resources to Lead Growth and Create New Businesses

Providing Opportunities for Growth Aligned with Our Business Strategy

SoftBank Academia

SoftBank Academia was established in 2010 by current Board Director and founder Masayoshi Son with the aim of identifying and fostering both potential successors to lead the SoftBank Group and people who will take up the challenge of our AI cluster strategy. Through a variety of programs, the approximately 300 SoftBank Academia students learn with and from one another.

Participants are recruited widely, from both inside and outside the SoftBank Group. The programs are well-rounded and varied. They include a presentation program based on themes related to management issues pertaining to the SoftBank Group; the Management Game, which simulates corporate management; special lectures on management theory presented by Masayoshi Son; and conversations with distinguished guests.

SoftBank Academia is both a place for the practical study of management and a forum where students, gathered from within and outside the SoftBank Group, encourage each other in friendly rivalry. It will continue to evolve as an agora whose members strive to be the best they can.

SoftBank Academia Programs

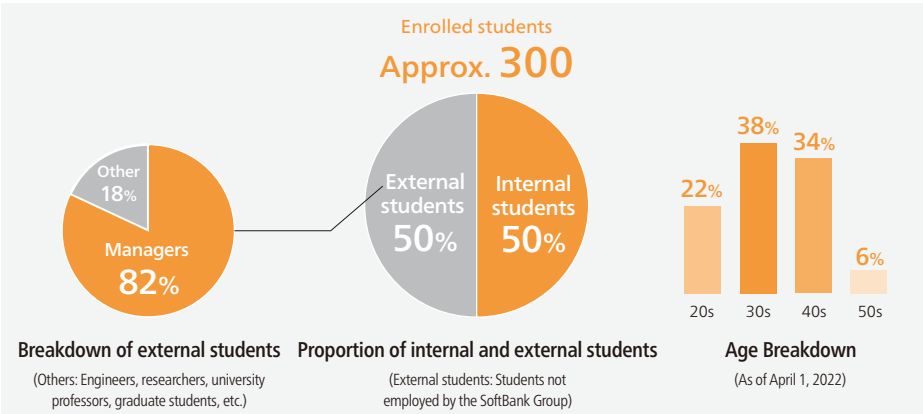|		
1	Presentation program	Students present their ideas on a topic set by Masayoshi Son that relates to business issues facing the SoftBank Group. Those who make it through a preliminary round get the opportunity to make their presentation in front of Son and other senior management of the SoftBank Group.
2	Management Game	The Management Game involves each participant acting as the manager of a company in competition with other SoftBank Academia students, fostering management skills such as strategy development, and responding to circumstances with quick and appropriate decisions.
3	Special lectures	These lectures include presentations by Masayoshi Son himself on his approach to management theory and panel discussions with well-known business leaders.
4	Conference	Generally held once a year, the conference provides a venue for information sharing and includes presentations by Academia students on their work over the previous year. The conference is held in a hybrid online/offline format, fostering connections among participants in different locations.
5	Study groups	SoftBank Academia students take the lead in planning study groups on topics that they want to learn more about. Students are free both to choose any topic they want and to participate in any study group that sparks their interest.
6	Projects	These projects are voluntary and run to their own schedule. Examples include special projects directly overseen by Masayoshi Son and collaborative projects undertaken in partnership with SoftBank Group companies.

TURE-TECH Regional Revitalization Internship Program

When hiring new college graduates, SoftBank Corp. searches far and wide for diverse talent who can support next-generation businesses. For this purpose, we conduct the Job-Match in-person internship program, the Beyond Border Week Challenge online work-experience program and the TURE-TECH internship program for regional revitalization.

TURE-TECH is an internship program for students aiming to become the "change leaders" who will build the world of the coming era. Japan is confronting many issues earlier than other nations, and interns in this regional-revitalization program seek solutions to problems facing local governments by traveling to regions of interest and interviewing city employees, local residents and business owners. On the last day of the internship, the interns submit to the mayor of the municipality a proposal for solving problems using ICT.

In September 2022, the TURE-TECH internship program was held fully online, due to the COVID-19 pandemic. Through online interviews and local live broadcasts, participants developed proposals for solving specified issues and presented them to the mayor of the participating city.

SoftBank Corp.'s mission is "Information Revolution—Happiness for everyone." By bringing students directly to the places where this revolution is needed, SoftBank Corp. provides interns of diverse backgrounds with real-world, hands-on experience that goes beyond armchair theorizing in search of solutions to problems that have no pre-defined answers.

Enrolled students
Approx. 300

Other 18%
Managers 82%

External students 50%
Internal students 50%

22% 20s
38% 30s
34% 40s
6% 50s

Breakdown of external students
(Others: Engineers, researchers, university professors, graduate students, etc.)

Proportion of internal and external students
(External students: Students not employed by the SoftBank Group)

Age Breakdown
(As of April 1, 2022)

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Value Creation 3 **Build Systems to Recruit and Develop Human Resources to Lead Growth and Create New Businesses**

Research and Development in Support of Operations

SoftBank Corp. has evolved by incorporating a wide variety of corporate cultures and integrating diverse personnel and the technologies it has gathered. Looking to the future, SoftBank Corp. aims to acquire data through its communications infrastructure and analyze and recombine it on a wide range of platforms to create novel value that enriches people's lives. To this end, SoftBank Corp. will build a robust communications infrastructure focused on 5G and press forward with the development of leading-edge technologies, including AI, IoT, robotics, digital twin, and even 6G and the stratosphere-based high-altitude platform stations (HAPS), raising the sophistication of its communications platform to new heights. Never resting on our latest achievements, we will press ever onward, tackling the challenges of technological development to contribute to the provision of solutions and new value.

Future Core Digital Technology Co-creation Lab

SoftBank Corp. and the National Institute of Advanced Industrial Science and Technology (AIST) launched the Future Core Digital Technology Co-creation Lab project in December 2021. Through this project, we are coordinating efforts to create the architecture and promote the R&D and social implementation of elemental technologies for next-generation infrastructure, including that for smart cities, a promising approach to solving social issues while promoting future growth.

The Future Core Digital Technology Co-creation Lab project is aimed at realizing Society 5.0 with next-generation digital technology that integrates physical space with cyber space in advanced ways, such as smart cities and digital twin technology. To this end, the project is advancing R&D and the social implementation of cutting-edge digital technologies and global-standard next-generation infrastructure. Furthermore, in addition to SoftBank Corp. and AIST, we are considering coordination with other companies and research institutions in order to build social platforms for safe and secure data linkage.

Specifically, the Future Core Digital Technology Coordination Laboratory has been set up within the project to implement joint research aimed at building platforms for the seamless integration of physical and cyber space. The laboratory's initial research focus is to build a spatiotemporal data platform for understanding three-dimensional spaces as well as the movement of people and other things through them over time. We are advancing R&D with the aims of applying the results in this area in the real world and to new research areas.

Furthermore, SoftBank and AIST will actively promote personnel exchange through joint research in order to develop talent to build future-oriented digital infrastructure.
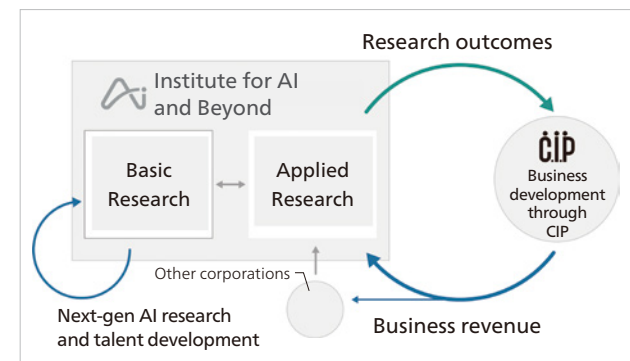
The Institute for AI and Beyond

SoftBank Corp., the University of Tokyo and other partners established the Institute for AI and Beyond as an AI research institution. The Institute launched joint-research operations in July 2020.

The Institute for AI and Beyond pursues research in two directions: basic research (medium- and long-term research), aimed at creating new academic fields through research into fundamental AI technologies and their fusion with other academic fields, as well as applied research (high-cycle research) that aims to utilize AI to address various social and industrial issues.

Until recently, university research institutes were unable to directly invest in businesses. As a result, universities could recoup only limited returns on the results of their research through such means as patent licensing, in some cases making it difficult to pursue ongoing research.

The Institute for AI and Beyond aims to promote AI research in Japan and contribute to its social implementation by combining the world-class academic prowess of the University of Tokyo and the business insight of SoftBank Corp. accumulated through its efforts to create new social value. We will actively utilize the new Collaborative Innovation Partnership (CIP) system established by the Ministry of Economy, Trade and Industry to create a positive cycle of accelerating business deployment and using the returns to further research and education. By doing so, we will realize ongoing research and the social implementation of research results.

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Value Creation 3 Build Systems to Recruit and Develop Human Resources to Lead Growth and Create New Businesses

Research and Development in Support of Operations

The SoftBank Next-generation Battery Lab

The diversification of mobile devices seen in recent years is driving a worldwide push to develop next-generation batteries. In June 2021, SoftBank Corp. established the SoftBank Next-generation Battery Lab, a facility for the evaluation and testing of a wide array of next-generation batteries from around the world. The Lab's aim is to conduct R&D on next-generation batteries that will be safe with high mass-energy density (Wh/kg) and rapidly commercialize them.

By evaluating and comparing the cells of manufacturers from around the world under controlled conditions, the Lab is able to rapidly analyze differences in performance and identify technological issues. The Lab's test results will be fed back to manufacturers to accelerate the development of next-generation batteries.

Next-generation Batteries Targeted by SoftBank
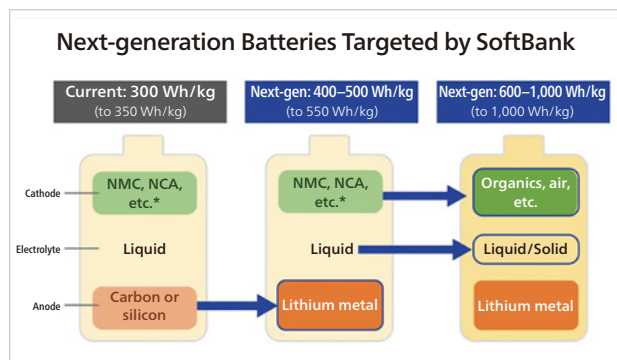
* NMC: Ternary cathode (nickel, manganese, cobalt); NCA: Nickel-rich cathode (nickel, cobalt, aluminum)

In October 2021, the Lab, in collaboration with its research partners, announced three research achievements: the development of cathode materials for all-solid-state batteries aimed at high mass-energy density; the development of a capacity prediction model for organic cathode materials using materials informatics (MI); and the prototype demonstration of a 520 Wh/kg cell. The success of these demonstration experiments is a major step toward the practical application of lithium-rich cathodes, which remains largely unprecedented globally. These achievements are expected to accelerate the development of next-generation batteries to be utilized in existing IoT and other devices that require high mass-energy density, and in next-generation communication systems, such as stratosphere-based high-altitude platform stations (HAPS).

The SoftBank Next-generation Battery Lab will continue working to be a platform that spurs and supports the development of next-generation batteries.
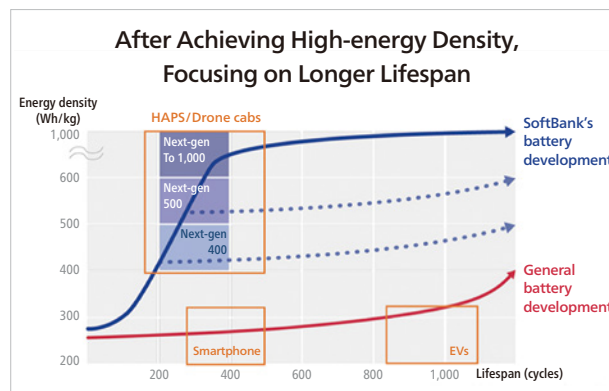
After Achieving High-energy Density, Focusing on Longer Lifespan

Agreement Aimed at Establishing a High Quality Lineage of Sturgeon for Practical Aquaculture Using IoT, AI and Biology

SoftBank Corp. and the Graduate School and Faculty of Fisheries Sciences at Hokkaido University are conducting a joint research project on the smart aquaculture of sturgeon using IoT and AI technology to support the fisheries industry. On March 28, 2023, SoftBank Corp., Hokkaido University, and the Town of Bifuka, Hokkaido, signed an industry-academia-government partnership agreement aimed at establishing a high-quality lineage of sturgeon for practical aquaculture using the power of IoT, AI and biology.

Sturgeon require at least six years of rearing before they can lay eggs, and male and female sturgeon remain indistinguishable for two to three years following birth, making them very costly to raise. Furthermore, once immature sturgeon roe begin to grow, water contamination, however brief, can have a tremendous impact on caviar quality, making it difficult to guarantee quality. Making the growth period as short as possible can therefore reduce the risk of quality degradation. Through the new agreement, we aim to establish a high-quality lineage of sturgeon for aquaculture using Hokkaido University's biology expertise and SoftBank Corp.'s IoT and AI technologies, with the aquaculture being carried out by the town of Bifuka.

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Value Creation 3 **Build Systems to Recruit and Develop Human Resources to Lead Growth and Create New Businesses**

Research and Development in Support of Operations

Joint Research on the Smart Aquaculture of Sturgeon Launched in February 2020

In addition to the real-time collection and analysis of underwater and above-water image data and environmental data using IoT devices, our joint research on the smart aquaculture of sturgeon uses 3D computer graphic (CG) simulation data of individual sturgeon swimming in a variety of virtual environments based on a CG musculoskeletal model of the sturgeon. The 3D CG model of the sturgeon is generated based on the skeleton and muscles of the fish. Unlike conventional animation models, it reproduces realistic musculoskeletal 3D CG that enables biologically based simulation. By promoting the use of detailed fish 3D CG, we aim to contribute to a wide range of fields in the fisheries industry, including aquaculture, education and R&D.
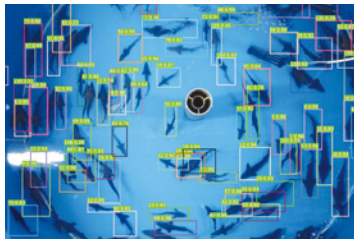
Sturgeon tracking result

Sturgeon musculoskeletal model

This joint research is expected to produce results that will help secure sustainable fishery resources. The project will continue to examine the potential and feasibility of various technologies in the fisheries industry with the aim of establishing low-cost, safe and environmentally friendly aquaculture methods using IoT and AI.

Launch of SoftBank Fish Cages Research Aimed at Optimizing Feeding in Red Seabream Aquaculture Using IoT and AI

In March 2023, we set up SoftBank fish cages for red seabream in Ehime Prefecture to carry out demonstration experiments aimed at optimizing feeding. In prior research, we successfully developed technology to automatically count fish using deep learning. To promote further innovation in aquaculture, SoftBank Corp. set up its own fish cages to carry out novel experiments.

Red seabream tend to avoid underwater cameras, making it difficult to acquire good underwater footage of them. Using our own fish cages, we are acclimating our red seabream to the presence of cameras. This will allow us to not only gather data for behavioral analysis, but observe and track the growth of individual fish. It will enable quantitative evaluations of feeding based on such parameters as feeding methods and amounts, facilitating responses to changes in the physical condition or appetite of fish and thereby enabling enhanced health management and culture efficiency.

We are also using IoT devices and building cloud services for continuous data collection. Data will be collected in the cloud, analyzed using AI and used to optimize feeding amounts and timing. These technologies are expected to not only improve efficiency for red seabream aquaculture professionals, but enable the aquaculture of red seabream using only fishmeal-free plant-based protein, which until now has been a challenge, thereby contributing to ocean sustainability.

By combining AI and IoT, we will blaze the trail toward a sustainable future for
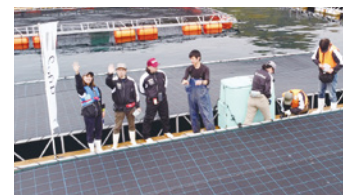
SoftBank fish cages

the fisheries industry and continue to push onward toward a new chapter of the aquaculture industry.

Research Paper Accepted by NeurIPS 2022: Autonomously Simulating Fish Schooling Behavior Using Deep Reinforcement Learning

As part of the R&D that supports its businesses, SoftBank Corp. presents research papers on its research achievements. A paper authored jointly by SoftBank Corp. and U.S.-based NeuralX, Inc. was accepted by Neural Information Processing Systems 2022 (NeurIPS 2022), a top-ranked conference in machine learning held in New Orleans, in the United States, in November 2022. The paper was titled "DeepFoids: Adaptive Bio-Inspired Fish Simulation with Deep Reinforcement Learning."

Feeding is an extremely important aspect of aquaculture in terms of maintaining the aquatic environment and promoting efficiency. However, feeding is currently dependent on the gut feelings and experience of human staff based on their observations of fish behavior from above the water's surface, as there is no effective way to monitor fish underwater. Until now, no method has been proposed to autonomously simulate fish schooling behavior while accounting for differences in such factors as cage size, fish density and fish species.

In this study, we simulated fish schooling behavior, which is essential to creating a feeding simulation. Using deep reinforcement learning, we showed that fish behave differently in sparse and dense conditions and verified our results by comparing them to actual video footage.

With further research, we expect that the simulation of feeding conditions will enable us to propose optimal feeding methods based on cage size, fish species, fish numbers and environmental conditions.

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