Research and Development

Basic Approach

Based on our unique "printing technologies," we advance R&D through coordination between operating companies' technology-related departments, intellectual property departments, and Group companies, centered on our Technical Research Institute, with the view to "breathing life into culture, with technology and heart," as set forth in our Purpose.

The TOPPAN Group's core technologies—"Information Processing," "Microfabrication," "Surface Treatment," "Material Forming," and "Marketing Solutions"—have unique attributes, and we provide new solutions by combining them. We will enhance and expand our technologies, maximize Group synergies, and create new value by co-creating with customers, universities and startups, as well as generating new businesses targeting global social issues and driving transformation of our business portfolio.

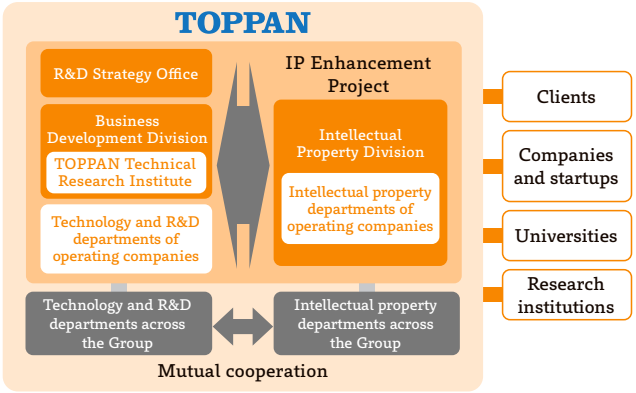
Governance

Research and Development Framework

We advance R&D activities centered on our core technologies from a market-oriented perspective. The R&D Strategy Office and Business Development Division work with operating companies' technology development departments. The R&D Strategy Office pursues infrastructure for cross-departmental technical administration, while the Business Development Division drives research, business development, and strategic investments to create new businesses as a disruptive innovator.

We also strategically build and use intellectual property, generate R&D synergies within the Group, and collaborate with clients and external research institutions to advance R&D activities and deliver new value to address today's shifting society and global environment.

Research and Development Framework



● TOPPAN Technical Research Institute

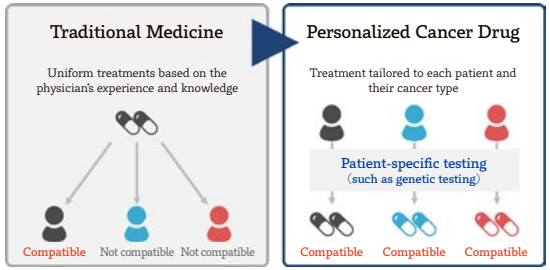
Our central research facility, the TOPPAN Technical Research Institute (est. in 1986 in Sugito, Saitama) promotes research integration, interdisciplinary exchanges and technological development, and cross-border Groupwide collaborations.

It focuses on fundamental research on next-generation technologies and development of original, competitive products and services. It also utilizes advanced expertise to provide technical support to business divisions.

An example is "invivoid™," a 3D cell culture technology jointly developed in 2017 with Professor Michiya Matsusaki of the Graduate School of Engineering at Osaka University. Harnessing unique biomaterials and co-culturing multiple cells in three-dimensional structures creates artificial tissues closely resembling living tissues. This has potential applications in diverse fields—personalized cancer care, drug discovery research including efficacy and toxicity testing, regenerative medicine, and cultured foods. Targeting commercialization, R&D is being conducted at our research institute, building a robust international patent network with the Intellectual Property Division.

As part of our efforts for personalized cancer care, since May 2023, the Japanese Foundation for Cancer Research (JFCR), Osaka University, and TOPPAN Holdings have been conducting clinical research to predict anticancer drug efficacy using invivoid™. When employing "cancer-patient avatars" cultured from patient-derived cancer cells using invivoid™ to assess the response of multiple anticancer drugs, results showed a high rate of matching with the outcomes of administering the same drugs to patients*1. We will further develop methods for selecting anticancer drugs using invivoid™, targeting personalized cancer care providing optimal anticancer drugs for each patient. We aim to obtain advanced medical designation in Japan*2 in fiscal 2025 and enter the clinical testing business in the U.S. in 2026.

Concept for Personalized Cancer Care



*1 Results published in scientific journal *Acta Biomaterialia*.
Yuki Takahashi et al., *Acta Biomaterialia*, Vol.183, 111-129, 2024.
*2 Advanced medical treatment refers to innovative technologies not covered by insurance but approved by the Minister of Health, Labour and Welfare.

We are also expanding invivoid™ applications and focusing on technological development for cultured meat, with a view to commercialization from 2031. We established a consortium in 2023 with Osaka University, Shimadzu Corporation, Itoham Yonekyu Holdings, and SIGMAXYZ Holdings (ZACROS Corporation joined in May 2024) to pursue social implementation of food-grade cultured meat technology using 3D bioprinting. TOPPAN Holdings is responsible for optimizing muscle and fat tissue and developing extracellular matrix materials (bio-ink and binders) to reproduce texture and structure close to real meat. At Expo 2025, we showcased cultured meat and a concept model meat maker, proposing a "kitchen of the future" concept: turning meat from 'something you buy at the store' to 'something you make at home.'

Cultured Meat and Exhibition Booth at Expo 2025

Strategy and Measures

Issues and Responses

In R&D, competitive advantages and commercialization of new businesses are essential for business portfolio transformation. To address this, we are strengthening analysis of information on external trends (macro trends, developments in industry-government-academia, etc.) and promoting external collaboration.

In December 2024, we signed a basic agreement with JFCR for comprehensive collaboration on new businesses leveraging mutual knowledge and technologies to address challenges in the medical field.

JFCR and TOPPAN Holdings previously advanced joint research on anticancer drug evaluation technologies, and with this comprehensive collaboration, we aim to build on past joint research and combine JFCR's clinical data and insights with our technologies and services—including automatic recognition, AI, and DX/SX, to create businesses addressing challenges in healthcare. For other topics, we are also pursuing competitive advantages and commercialization through external collaboration.

New Business Creation Themes

We have been creating new businesses addressing social and industrial issues by leveraging business models and technologies with a competitive edge. For example, 3D ToF sensors*1 are used for detecting obstacles and steps in autonomous robots and small mobility vehicles (compact, more eco-friendly vehicles for one or two people), as well as for gaming applications such as user self-location and environmental mapping. For these applications, most are compact battery-operated devices, and onboard 3D sensors are required to deliver high-precision distance measurement, low power consumption, low latency, and miniaturization.

In 2023, we developed a Hybrid ToF™*2 sensor for robotics, offering long-range measurement, outdoor measurement, high-speed imaging, and simultaneous operation of multiple units. We have recently developed a second-generation sensor, the TPHT4040, which can be installed on compact robots and smart glasses. The new version incorporates "HDR"*3 and "pixel binning"*4 functions, enabling more precise distance measurement and optimized data transfer. It also has a "deep power down mode" to reduce power consumption, and circuit design optimized for a smaller sensor chip, making it ideal for various applications, such as compact serving robots, robot vacuum cleaners, and battery-operated smart glasses.

Target Applications of the New ToF Sensor

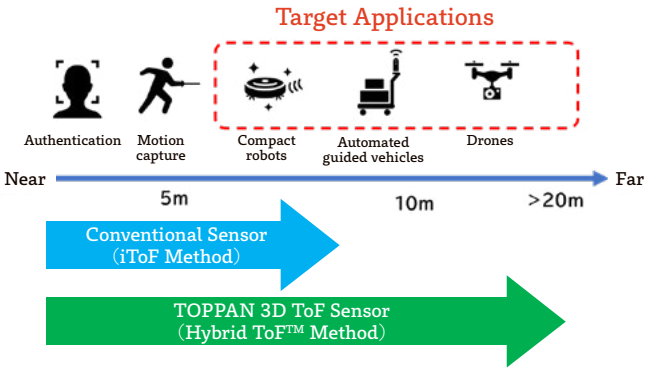
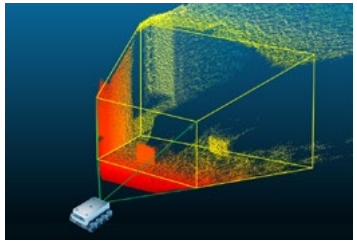


Illustration of 3D ToF Sensor Installed in a Compact Robot



*1 3D ToF Sensor: Measures 3D distances from cameras to objects using infrared light.
*2 Hybrid ToF™: Fuses the short pulse ToF method and sensor control using multi-time-window technology. Also refers to sensors and cameras using the technology. Features strong resistance to external light and image blur, enabling capture of fast-moving objects and outdoor use unaffected by sunlight.
https://www.holdings.toppan.com/en/news/2022/06/newsrelease220616.html
*3 High Dynamic Range (HDR) function: Captures multiple range data with different exposure times as a single range image.
*4 Pixel binning: Combines data from multiple pixels and treats them as a single large pixel.

Acquisition of Intellectual Property Rights (see page 87) >

Investing in Startups

TOPPAN has invested in more than 70 promising startups around the world since 2016. The joint ventures we enter with these startups bring us closer to the goals of the Medium Term Plan, our roadmap to becoming a leading provider of solutions for global society through DX and SX initiatives.

In June 2022 we founded a corporate venture capital (CVC) fund in the U.S. to secure overseas funding for the development of businesses.

In fiscal 2024, we formed capital and business alliances with five domestic startups, invested in three overseas startups, and acquired one company. Two domestic investee companies have also gone public.

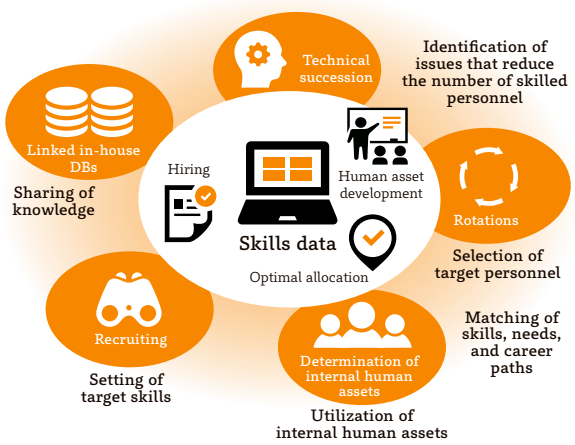
Our efforts have been recognized, and in January 2025 TOPPAN Holdings was ranked first in the "Morning Pitch Large Enterprise Innovation Award 2025," which ranks large companies proactive in collaboration with startups. We will continue to promote collaboration with innovative startups in the future.

Fostering R&D Talent

TOPPAN strives for technological enhancements through the strategic utilization of our human capital. In fiscal 2020 we began surveying employees in technology departments of the Group to rate their technical skills and consolidate the skills we identify into a skill map.

The skill map allows us to better foster human assets equipped with digital skills. Fostering talent in the data science field is crucial for research and development. In particular, we are focusing on developing talent capable of utilizing materials informatics (MI), which is considered effective for efficient materials development, and are implementing this across the Group.

Overview of Skill Map Utilization



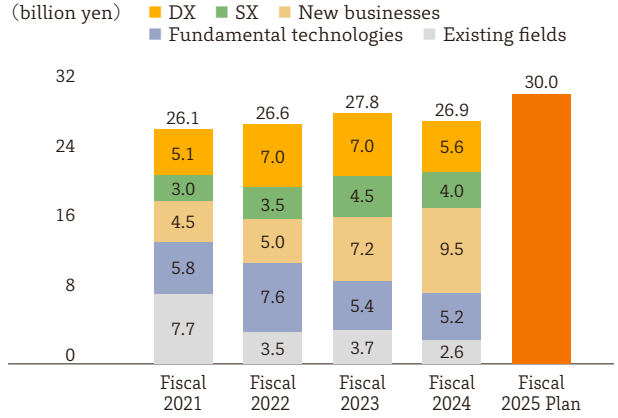
Data

R&D Investments

The TOPPAN Group has boosted investment of resources into research and development to create new businesses with a view to transforming its business portfolio starting from fiscal 2020. Fiscal 2020-2022 and fiscal 2023-2025 are positioned as the "foundation building phase" and "result delivery phase," respectively.

In particular, we have designated key investment fields that address current social issues and technological trends (shown in the table on the right), and are strengthening them along with the budget for establishing the foundational environment that supports these key fields, aiming to enhance our technological capabilities and accelerate business creation.

R&D Expenditure



Business Model/Field	Main R&D Objectives
DX	AI-related technologies / solutions for local government administration / digital marketing / digital platform business / BPO / IoT-related technologies / smart city initiatives & community planning, etc.
SX	Mono-material related / switch to paper materials / recycling & upcycling technology / biomass related / biodegradable materials, etc.
New businesses	Metaverse-related business / healthcare business / 3D cell culture technology / fuel cell components / quantum dots / energy business / genome editing / robotics / agri-related fields, etc.
Fundamental technologies	Materials and analysis technology / improvement of service quality infrastructure / converting technology / microfabrication technology / etching technology / intellectual property / AI / security technology, etc.