

Research and Development

Basic Approach

Approach

In the more than 120 years since its foundation, the TOPPAN Group has evolved its original specialization of printing skills into printing techniques. Technical advances in printing, coupled with the fusion of varied knowledge and expertise with processing technologies, have enabled us to systemize “printing technologies” of our own. Five core technologies now drive our business: Information Processing, Microfabrication, Surface Treatment, Material Forming, and Marketing Solutions. These five technologies and the distinct benefits they offer are combined into the new solutions we offer.

By strengthening core technologies to maximize synergies within the Group, TOPPAN is steadily generating new value for society through co-creation with clients, universities, and startups. We will continue deepening and expanding our unique technologies to develop new businesses that provide solutions to global social challenges and transform our business portfolio.

Research and Development Framework

Framework

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

TOPPAN also strategically builds and uses intellectual property, generates R&D synergies within the Group, and collaborates creatively with clients and external research institutions to advance R&D activities. In these ways, we deliver new value to address today's shifting society and global environment.

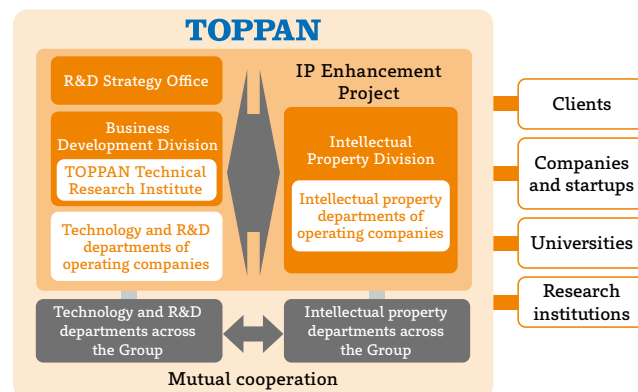
TOPPAN Technical Research Institute

Framework

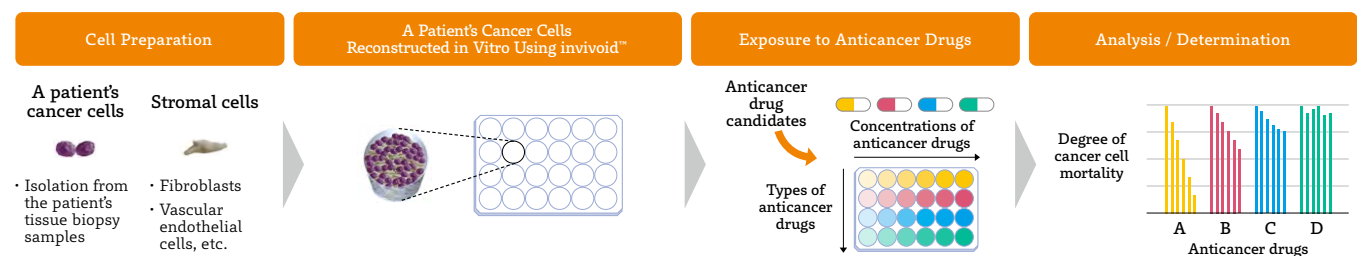
Our central research facility, the TOPPAN Technical Research Institute (est. in 1986 in Sugito, Saitama Prefecture, Japan) promotes research integration, interdisciplinary research exchanges and technological development, and cross-border Groupwide research collaborations. Its primary focuses are fundamental research to usher in next-generation technologies and the development of highly original, competitive products and services. The institute also utilizes its advanced expertise to provide technical support to TOPPAN business divisions.

invivoid™, a forefront 3D cell culture technology using proprietary biomaterials, was developed jointly with Professor Michiya Matsusaki from the Graduate School of Engineering at Osaka University. In one of its various R&D projects to promote the social implementation of this technology, the institute is using invivoid to reconstruct 3D tissues in vitro from tissues

Research and Development Framework



Anticancer Drug Selection Test



removed from patients in cancer surgery. The reconstructed tissues, called “cancer-patient avatars,” will serve as new experimental materials that are likely to obviate the need for conventional mouse experiments in anticancer drug trials. These avatar tissues are already used in a clinical study the institute has launched in Japan in partnership with the Japanese Foundation for Cancer Research. Specifically, researchers are administering multiple anticancer drugs to both avatar tissues and actual patients to compare the cancer responses. In October of 2023, the institute began collaborating with The University of Texas MD Anderson Cancer Center (MDACC) on testing to evaluate new immunotherapeutic drugs MDACC has been studying in the U.S. Researchers from MDACC and TOPPAN are using cancer-patient avatars equipped with immune functions as models to evaluate new drugs. Through this research, TOPPAN seeks to acquire a CLIA certification* and launch a cancer testing business in the U.S. Our ultimate goal is to personalize the selection of anticancer drugs for every patient.

*The Clinical Laboratory Improvement Amendments (CLIA) are a set of regulatory revisions legislated in the U.S. in 1988. CLIA authenticates that the clinical tests performed in healthcare laboratories meet the quality standards required in the U.S. This certification confirms the reliability of test results for patients and healthcare providers.

New Business Creation Themes

Policy

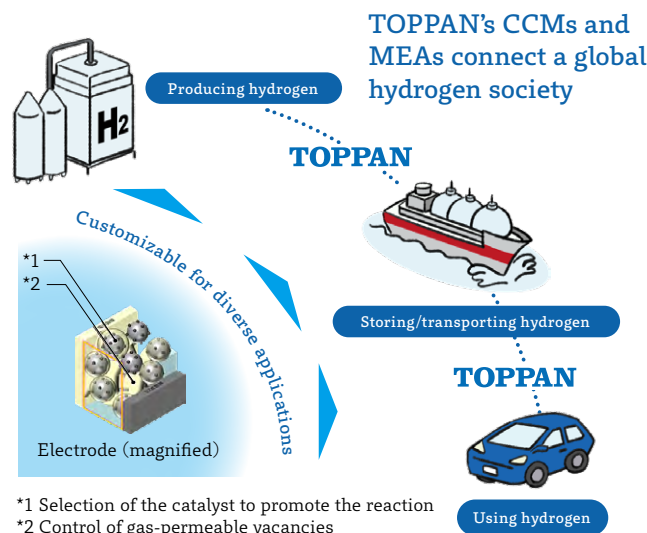
TOPPAN has been creating new businesses that address social and industrial issues by leveraging business models and technologies that give us a competitive edge.

One notable venture we are committed to is the development of membrane electrode assemblies (MEAs), core components of fuel cells. Fuel cells have been attracting worldwide attention as a key technology in the coming hydrogen society. These zero-emission power generation devices supply electricity from hydrogen and air, and discharge water alone.

TOPPAN's MEAs are distinguished by a single-wafer manufacturing process in which both sides of an electrolyte sheet are coated with catalyst ink at the same time. Another feature is the high energy-conversion efficiency achieved by the catalyst structure and the special materials added to it. Thanks to our patented technologies, TOPPAN's MEAs have been evolved into products that have higher operational performance and durability, more customizability for individual users, and superior market competitiveness. Their sales were launched in August of 2023, soon after the operational startup of our manufacturing facility at the Kochi Plant in Japan. MEAs are generally used for producing hydrogen, as well as for storing, transporting, and using it. We will be supplying our MEAs to customers across the hydrogen energy field to help the international community achieve carbon neutrality.

 More details on the Acquisition of Intellectual Property Rights (see page 73) >

Diverse Applications in a Hydrogen Society



Investing in Startups

Policy

Activity results, performance data

TOPPAN has invested in more than 60 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 more overseas funding for the development of businesses. Our focus is on partnership with innovative North American startups that are technologically able to develop novel eco services and products.

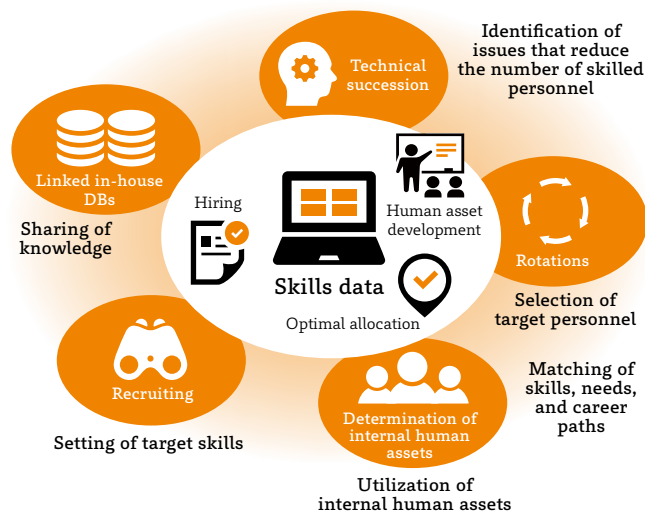
Fostering R&D Talent

Policy

TOPPAN strives for technological enhancements through the strategic utilization of our human capital. In fiscal 2020 we began surveying employees in technology departments across 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. At present, for example, we are enriching our pool of personnel capable of leveraging AI and analyzing big data. In R&D, in particular, we focus on the development of human assets who can apply materials informatics (MI) methods assumed to be effective for efficient materials development.

Overview of Skill Map Utilization



R&D Investments

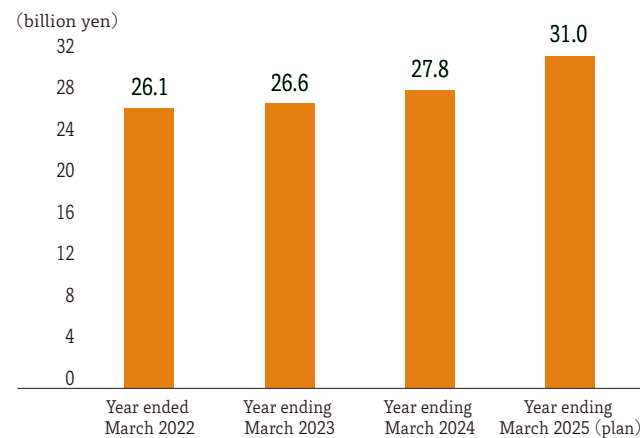
Policy Activity results, performance data

The TOPPAN Group advances research and development to create new businesses with a view to transforming its business portfolio. We have defined key fields in which to invest R&D resources on a priority basis, starting from fiscal 2020. Fiscal 2020-2022 and fiscal 2023-2025 are positioned as the “foundation building phase” and “result delivery phase,” respectively.

Seeds have been planted to achieve results in fiscal 2023 and beyond through increased R&D budgets for technological enhancements and the faster creation of new businesses. The bulk of the R&D funding is spent in key investment fields that address current social issues and technological trends (shown in the table on the right) and in the establishment of technological platforms and other foundations that support efforts in those key fields.

Business Model/Field	Main R&D Objectives
DX	AI/IoT businesses, solutions for local government administration, digital marketing, digital platform business, BPO, smart city initiatives & community planning, etc.
SX	Mono-material compositions, switch to paper materials, recycling/upcycling operations, biomass business, biodegradable materials, etc.
New businesses	Metaverse-related business, healthcare business, 3D cell cultures, fuel cell components, quantum dots, energy business, genome editing, robotics, agribusiness, etc.
Next-generation communications	Next-generation FC-BGA substrates, sensors, etc.
Fundamental technologies	Materials/analysis, foundation for service quality improvement, converting, microfabrication, AI business, security business, etc.

R&D Expenditure



Fiscal 2023 Breakdown of R&D Investment Fields

